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Conceptual Design Report

Research Support Building

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Project Number 04-LBNL
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DOE/OAK
CONCEPTUAL DESIGN REPORT
REVIEW CHECKLIST

Project Title: RESEARCH SUPPORT BUILDING

Date of CDR: FEBRUARY 2002 Project Location: BERKELEY LAB

In the space provided below, please indicate where the item is located in the CDR, e.g. page number, section, etc. If not applicable, then indicate N/A and explain in writing.

1)	1-1	Project justification.
2)	Section 2	Detailed description of the project scope.
3)	Section 2	Performance requirements (facility/building/system/ process).
4)	Section 3	Project cost estimate.
5)	9-5 to 9-27	Cost estimate assumptions and methodology.
6)	3-1	Cost estimate date.
7)	3-1	Identification of the originator of the cost estimate.
8)	3-1	Escalation rates used in cost estimate.
9)	None	Major areas of cost uncertainties.
10)	3-6	Financial schedule (annual obligation/cost requirements).
11)	1-2 to 1-3	Discussion on alternatives considered.
12)	9-59	Life cycle cost analysis of proposed project and alternatives.
13)	Section 4	Schedule with major milestones and critical path identified (design, procurement, construction, mid-point of construction, environmental compliance and safety analysis).
14)	None	Schedule constraints (funding, seasonal, R&D related, etc.).
15)	1-3	Method of performance (acquisition strategy) for design, procurement and construction.
16)	3-4	Work breakdown structure.
17)	Section 8	Safeguards and security requirements.
18)	Section 8	Safeguards and security features incorporated.
19)	Section 7	Energy conservation design/construction features.
20)	Not Included	Estimates of energy consumption and types of energy supply.

Project Title: RESEARCH SUPPORT BUILDING

21)	Section 8	Health, safety and fire protection hazards/risks.
22)	8-1	Health, safety and fire protection features.
23)	8-2	Schedule for safety analysis review/documentation.
24)	8-1	Environmental hazards/risks.
25)	8-2	Discussion on level of required NEPA documentation.
26)	8-2	Environmental hazards/risks mitigation features.
27)	8-2	Schedule for NEPA compliance/documentation.
28)	8-1	Decontamination, decommissioning and disposal requirements.
29)	2-13 to 2-15	Discussion on project quality assurance to satisfy program and project objectives.
30)	Section 2	Range of facility/building/system/process operating conditions.
31)	Not Included	Required facility/building/system/process degree of reliability.
32)	1-2	Intended useful life of facility/building/system/process.
33)	Section 1	Discussion on maintenance, repair and replacement of facility.
34)	2-10	Telecommunications requirements.
35)	None	Computer equipment requirements.
36)	2-3	Provision for access and use by the physically handicapped.
37)	None	Provision for fallout shelters.
38)	N/A	Discussion on project uncertainties/risks and effort required to resolve.
39)	3-8	Contingency requirements and analysis.
40)	5-3 through 5-5	Site development plan (including utilities) drawings.
41)	5-7 through 5-15	Building layout (plan and elevation views) drawings.
42)	5-26 through 5-32	Major equipment layout drawings.

Project Title: RESEARCH SUPPORT BUILDING

43)	None	Piping and instrumentation drawings.
44)	5-21	Process and HVAC layout drawings.
45)	Section 1	Discussion on facility siting, site development plan, site development requirements and real estate issues (easements, permits, etc.).
46)	N/A	Utility service requirements, utility sources, modifications to existing utility arrangements/agreements (easements, permits, etc.).
47)	6-1 to 6-3	List of major standard equipment and special facilities.
48)	N/A	Discussion on space utilization/building efficiency ratio.
49)	Section 6	Construction types and materials.
50)	Section 6	Outline construction specifications.
51)	2-10 to 2-11	Applicable codes, standards, regulations, DOE Orders, etc.
52)	9-31 through 9-40	Design loads (facility/building/system/process).
53)	9-41 through 9-48	Subsurface/geotechnical requirements.
54)	N/A	Strategic Facilities Initiative form.
55)	N/A	Migration plan.
56)	Last Page	Protection of Information disclaimer.

Contents

1. Summary and Justification

1.1 Summary

Located in Berkeley Lab's Civic Center area, the Research Support Building will be a new, four-level, state-of-the-art office building. Its 2,400 gross square meters (26,000 GSF) of flexible office space will bring together interrelated management and administrative support functions in a single, centralized office facility. Consolidation of these research support services will improve their effectiveness and convenience, yielding cost savings through collocation of interrelated activities, elimination of redundancy, and the productivity advantages of a state-of-the-art office environment.

Designed and constructed as a green technology building, the Research Support Building will incorporate numerous design features to enhance environmental sustainability. Sensitive site development, water and energy conservation, waste reduction, solar orientation, and superior indoor air quality will all receive full consideration, as will the use of environmentally responsible building materials that minimize environmental impact throughout their life cycle. The project will target a LEED™ rating of "Gold" for overall building sustainability performance.

The Research Support Building will provide an anchor for a future Civic Center. The Civic Center will encourage social interaction and strengthen the Berkeley Lab community by creating a distinctive public space for community gatherings, focusing pedestrian and bus service circulation, and clustering public functions such as central administration, library services, and conference facilities.

1.2 Project Justification

The Research Support Building will reduce annual operating costs by consolidating services, increase space for research, improve energy conservation, decrease maintenance costs, and reduce environmental impacts.

Operational Savings. Savings in annual operating costs will result from productivity gains, functional efficiency, energy conservation, reduced travel, and reduced maintenance cost associated with centralizing support services in a convenient location. The services that will be relocated to the new building are at present dispersed at several onsite and offsite locations. This hampers interaction between them and adds to travel time and inconvenience for customers. Relocating these services in the Research Support Building will improve their efficiency through centralized management, combined administrative activities, and reduced travel time. The result will be better support for researchers as well as for Berkeley Lab's directorate and public outreach activities.

Space Utilization. In addition to gains in operational efficiency, centralizing research support functions in the Research Support Building will free up approximately 12,000 S.F. of badly needed research space through relocation of research support functions, to new and less costly office space, while avoiding the cost of leasing space offsite. Relocation of Library Services from three separate locations to a centralized library facility will open space in existing laboratory buildings for use by researchers. At the same time, LBNL's library services will be improved by consolidating facilities and research documents in a central location and updating to current library technology. The Research Support Building will, in addition, provide the fire resistant storage needed for safe archiving of laboratory reports.

Sustainable Design. The use of sustainable design practices in the design and construction of the Research Support Building will conserve energy and minimize environmental impacts.

CAMP and RPM Ratings

This project was rated using the Capital Asset Management Process (CAMP) evaluation criteria and achieved a CAMP score of 65. The primary driver for this project was identified within the Mission and Investment criteria. The project will address each of the identified concerns. The full text of the rating analysis is contained in Section 9 of this report.

Evaluation of Alternatives

Alternatives to the proposed project were evaluated in a cost-effectiveness analysis conducted according to guidelines established in OMB Circulars A-11 and A-94. The full text of the cost-effectiveness analysis is included in Section 9 of this conceptual design report. The alternatives considered and their analyses are as follows:

1. **Maintaining status quo** (continue management and administrative functions from existing fragmented and dispersed locations).

   If a new Research Support Building is not provided, the highly interactive service and support functions will continue to suffer from inefficiency because of their fragmented and dispersed locations. Additionally, office space needs will continue to be critical, with associated efficiency losses.

2. **Consolidating administrative functions in leased offsite space.**

   A complete consolidation of these functions in leased offsite space is not possible because of the functional need to provide these services at a central onsite (LBNL) location. The cost of a 25-year lease for a 2,400 gross sq m (26,000 GSF) building would be approximately $20M. This alternative is significantly more expensive than the cost of a new building centrally located in the Berkeley Lab Civic Center.

3. **Construction of a new 2,400 gross sq m (26,000 GSF) building adjacent to Lab Civic Center** (proposed alternative).

   The proposed alternative of constructing a new building adjacent to the Lab Civic Center is the most cost-effective solution.

1.3 Basis of Conceptual Design

This conceptual design is based upon operational criteria developed from a thorough review of existing facilities. Functional criteria were established by:

- Carol Backhus, Head Library Services
- Laura Chen, Chief Facilities Planner
- Dick Dicely, Facilities Planner

The construction cost estimate was prepared by Davis Langdon Adamson, consulting professional estimators, based upon quantity and component take-offs from conceptual drawings and outline specifications.

1.4 Method of Performance

Engineering and Design

A building program and design criteria will be developed by the LBNL Facilities Department incorporating detailed functional requirements to achieve the proposed operational efficiencies.

An Architect and Engineering firm with appropriate multidisciplinary support and design experience will be selected for Titles I and II design and for technical oversight during Title III construction. The firm will be selected on the basis of qualifications, under a negotiated lump sum contract. The firm will be required to demonstrate knowledge of the EPA Comprehensive Procurement Guidelines for recycled content in building materials, and the US Green Building Council LEED™ Building Rating System for environmentally sustainable design and use of building materials that minimize environmental impact throughout their life cycle. Independent reviews of the structural design and construction cost estimate will be arranged by LBNL.

Construction and Procurement

Construction will be accomplished by lump-sum subcontract awarded on a competitive basis, using best value selection criteria that will include price and technical considerations. Construction contract administration and inspection will be accomplished by the LBNL Facilities and Purchasing Departments, with the assistance of the Architect and Engineering firm and appropriate testing laboratories under contract to the University.

The Architect-Engineer firm will review vendor drawings and Subcontractor submittals and provide construction observation and consultation as requested by the LBNL Facilities Department.

A Geotechnical Engineering firm will be selected to provide specialty inspection related to earthwork and geological considerations.

Some work associated with tie-ins and start-up may be accomplished by LBNL crafts to ensure operational continuity.

Project Management

LBNL has assigned a Project Manager who will be responsible for control of scope, budget and schedule throughout the life of the project from conceptual design through start-up.

1.5 Reliability, Maintainability and Operability

The Title I and II designs will be reviewed for reliability, maintainability and operability. The primary objective of these reviews is to assure the development of systems that will be reliable, safe, and easy to operate, and that can be maintained with minimum resources.

2. Project Description

The Research Support Building project will construct an office building with a total area of approximately 2,400 gross square meters (26,000 GSF) and 1,700 net square meters (18,000 NSF). The project will also add new surface parking for 26 cars.

By centralizing and improving access to related support functions that are now widely dispersed, the project will achieve operational economies and improved services for the Laboratory community. These functions include the following (current locations are in parentheses):

- Patent Department (Bldg 90B)
- Center for Science and Engineering Education (Bldg 7)
- Procurement Department (Bldg 937— offsite)
- Sponsored Projects Office (Bldg 90)
- Technology Transfer Department (Bldg 90)
- Library Services (Bldgs 50, 62, and 1—offsite)

The proposed design calls for a building massed in four levels and terraced into the site's sloped topography. This terraced design will allow grade access to the building's lower level for service and library deliveries. The main library entry will front on Lawrence Road, overlooking the Berkeley Lab Town Center. The new building will be an anchor for the Town Center, complementing other nearby facilities that provide centralized services to the Berkeley Lab community.

The Research Support Building will be constructed on the site of Building 29, a 1940-vintage structure, damaged by irreparable dry rot and pests, that has been condemned and will be removed. Temporary trailers 29A, 29B, and 29C will also be removed. All basic utilities exist near the Research Support Building site. Project siting conforms with the LBNL Institutional Plan and the LBNL Strategic Facilities Plan. Expected useful life of the building is 40 years.

2.1 Sustainable Design Principles

The Research Support Building will exemplify sustainable, healthy, and environmentally responsible design and construction. Its environmental impact will be minimized through attention to sensitive site development, water and energy conservation, indoor air quality, environmentally responsible building materials, and waste reduction.

Green building design features for architectural, structural, mechanical and electrical systems will be employed to the maximum extent possible, with the objective of obtaining a Green Building Council LEED™ "Gold" rating and an EPA/DOE Energy Star® building rating of 90.

Environmentally Sensitive Siting and Orientation

East and west exposures will be minimized. Sunshades, recessed windows, and landscaping screens will control southern solar loads.

Office Environment

Open office planning and a raised floor system will maximize flexibility. Highly reflective ceiling light shelves and indirect lighting will be used to reduce glare.

Indoor Air Quality

The building will have operable windows and adequate ventilation, and will use no- or low-emitting building materials and finishes (paint, sealants, carpet, cabinetry). Interior landscaping will serve as a low-tech means of removing pollutants from the air.

Energy Conservation

Insulation. To reduce heating and cooling loads, high R-value insulation will be installed external to the building's thermal mass. The building's double-glazed windows will have a spectrally selective low-emissivity coating, with U-value and solar heat gain factor optimized for each exposure direction.

Lighting. Light shelves, tall windows, and skylights will provide daylighting to reduce electrical demand. The building's integrated lighting controls will use photo cells, dimmers, and motion sensors to control power use in response to daylighting, occupancy, user preference, and load shedding conditions. Plug loads will have workstation occupancy sensor controls.

Indirect/direct lighting fixtures will have dimming electronic ballasts. Exterior lighting will consist of T5 fluorescent lamps with motion sensors. Exit signs will be electroluminescent (ELD). Energy-efficient office equipment will include Energy Star® computers, monitors, printers, fax machines, and copiers. An automated energy management system will be tied into the Labwide Facility Monitoring and Control System.

Building Systems. The design of building systems will promote energy efficiency. The HVAC system will use an under-floor supply air plenum and natural-convection-assisted low-pressure ventilation. Ventilation and temperature control will be based on individual preference and occupancy. Indirect/direct evaporative cooling will cool supply air. Ventilation ducts and pipes will be tightly joined and sized to minimize pressure drops.

Boilers. Heat recovery on the exhaust air stream will be used to preheat boiler water for space heating. The boilers will be modulating gas-fired with condensing heat exchangers. A condensing gas-fired water heater will provide domestic hot water; heat will be recovered from the waste water stream.

Electrical System. The electrical system will include loss-optimized circuit conductors and amorphous-core transformers. A grid-tied photovoltaic system will be integrated with roof material.

Plumbing. Low-flow and no-flow plumbing fixtures and water-saving appliances will conserve water. The building design will minimize construction waste through standard

dimensioning of materials, use of full-size panels, etc. Construction, demolition, and operational waste will be recycled.

Building Materials. Environmentally responsible building materials and finishes will be selected for their low environmental impact throughout their life cycles (raw materials, manufacturing, shipping, installation and use, and next use). Exterior siding will be maintenance-free, factory-finished metal. Interior finishes, including gypsum board, acoustical tiles, ceramic tiles, and carpet, will use recycled materials. Wood products will be certified, and will not include any wood products from old-growth forests. Paints and coatings will contain low-volatility or non-volatile organic compounds (VOCs). Structural and reinforcing steel will have 100-percent recycled content, with a minimum of 75-percent post consumer steel. Fly ash will replace up to 20-percent of portland cement. Concrete formwork will be reusable—constructed of steel, fiberglass-reinforced plastic, or wood.

2.2 Architectural Design

The Research Support Building will take advantage of the sloped topography of the site. The heavy loads of the library high-density stacks are located on grade at the lowest level. An energy-efficient 1,360-kg (3,000-lb) capacity passenger elevator will serve all floors.

The factory-finished metal siding for the building's exterior skin will require no painting or other maintenance. A standard built-up roofing system will include photovoltaic panels and a light-gray protective granular finish material to reduce cooling loads. Skylights and light wells will bring natural light to interior library spaces.

The primarily open office landscape, furnished with system partitions and furniture, will facilitate interaction between people and maximize flexibility. Enclosed offices will use a movable full-height panelized wall system to maintain flexibility. Table 2-1 summarizes space use in the Research Support Building (areas in square meters):

Table 2-1. Space Use

	Square Meters				
Room Function	Special Use	Private Offices	Open Wkstn	Other	Total
Programmatic Uses					
Patent Department	0	36	46	0	83
Center for Science & Engineering Education	93	11	64	55	223
Procurement Department	0	33	102	12	147
Sponsored Projects Office	0	14	37	16	67
Technology Transfer Department	0	28	111	30	169
Subtotal	**93**	**123**	**361**	**113**	**690**
Library Services	521	14	114	28	676
Total Programmatic Uses	**614**	**137**	**475**	**141**	**1,366**
General Useable Area	328	0	0	0	328
Total Useable Area	**942**	**137**	**475**	**141**	**1,694**
Total Non-assignable Area	0	0	0	742	742
Building Total Gross Area	**942**	**137**	**475**	**883**	**2,437**
Building Efficiency					**70%**

Design of the Research Support Building will conform with requirements for Group B Occupancy as defined in the California Building Code (CBC), and with seismic safety and fire safety code requirements. The building will be of Type II 1-hour-rated construction and maintain appropriate setbacks from existing adjacent structures. The building will comply with disabled accessibility requirements in accordance with the Americans with Disabilities Act (ADA).

2.3 Site Development

Existing Conditions. The site is currently occupied by Building 29 and four adjacent trailers which have been condemned. Demolition and removal of these condemned facilities will be completed in FY2002 using separate funding. This project will replace the 15,600 gsf of office and dry lab space formerly located in the demolished World War II era structures and inadequate trailers.

Environmental Considerations. There are no natural environmental issues that will require unusual design considerations for this project. The project will not impact any environmentally sensitive areas. Subsurface conditions have been reviewed and are unlikely to contain any contamination. See Section 8 for further discussion on environmental considerations.

Storm Drainage. The drainage system will be capable of handling a 100-year storm of 2.0 inches of rain per hour and will be connected to the existing storm sewer. Instead of discharging all storm water into the existing storm sewer, an effort will be made to retain it on-site where it has value. Permeable surfaces, plants, and swales will be used to slow stormwater velocity, remove pollutants, and infiltrate storm water into the soil. Where relocation of existing storm drainage facilities is required, careful measures will be taken to provide controlled diversion of storm water. Disturbed areas will receive final landscaping and seeding at the earliest practical time during construction so that ground cover will be well established by the next rainy season.

Earthwork. In all areas where excavations are to be made or fill deposited, the topsoil will first be stripped and stockpiled for dressing finished slopes and for use in landscaped areas. Cut and fill slopes will not be steeper than two horizontal to one vertical. Edges of cut banks will be well-rounded to blend into the natural terrain.

Site Utilities. Building utilities will be connected to existing nearby site utility systems.

Landscaping. Fire-resistive ground cover will be planted as needed for erosion control. Plant materials will be selected based on their indigenous, water saving, and low maintenance characteristics. Several existing trees must be removed to accommodate the new building. These will be replaced with native deciduous trees that will provide shade during the summer and solar access in the winter.

Paved Areas. Pavement will be asphalt concrete capable of handling truck loading. The extent of impervious surfaces will be limited, or surfaces with open pores will be used to allow storm water to infiltrate into the soil.

Parking. Parking for 26 cars will be provided by new surface parking spaces created by widening Lawrence Road and installing retaining walls.

2.4 Structural Design

The structural design will account for all loads to which the structure may be subjected including dead, live, wind and seismic. The design will comply with the requirements of the California Building Code (CBC) and LBNL's "Lateral Force Design Criteria."

The lowest building level will consist of concrete basement walls. The superstructure will be a structural steel special moment resisting frame in both orthogonal directions. The roofing system will be supported on metal decking and steel framing. Elevated floors will consist of composite lightweight concrete fill on metal decking and steel framing. The foundation system will consist of structural slab on grade over mat foundations founded on competent subsurface materials. Building retaining walls and site retaining walls will consist of tieback anchors, reinforcing steel and pneumatically applied concrete.

All floors will be designed for a minimum 50 psf live load. The stack areas of the library will be designed for 300 psf. The roof will be designed for a 20 psf live load. An excerpt from the conceptual structural calculations is included in section 9.

The foundation system will conform to the recommendations of Subsurface Consultants, consulting engineers and geologists. A copy of the Geotechnical Evaluation is included in section 9, Detailed Supporting Data.

Nonstructural building elements and the mechanical and electrical systems will be designed to accommodate calculated displacements due to lateral forces resulting from wind or seismic forces.

2.5 Mechanical Design

The design of mechanical systems for the Research Support Building will conform to the California Mechanical Code (CMC).

HVAC System

The Research Support Building will have an all-air system with year-round comfort control.

Building HVAC System

Air Distribution System. The building HVAC system will be a low velocity all-air VAV system with a single air-handling unit. Except for the first floor, air will be supplied to all zones using an under-floor air plenum fed from a central supply air shaft. Each zone will have user-adjustable floor-grille diffusers. Selected rooms will have automatic dampers to control airflow; all others will be manually controlled by the users.

Air will be exhausted from all zones through adjustable ceiling grilles feeding air to the above-ceiling exhaust plenum. All ducts will be thoroughly sealed. Where ducts pass through firewalls, fire and smoke dampers will have adjacent access doors and required fire stopping. To improve indoor air quality, there will be no return air in the building; all air is exhausted through either a heat-recovery coil or a cooling tower on the roof. The cooling tower will use exhaust air in the summer to boost indirect evaporative cooling capacity.

The building will have operable windows to provide additional local temperature and ventilation control for building occupants.

A fan will supply outside air to the elevator shaft to maintain positive pressure in the shaft.

Bathroom and Other Exhaust. A ducted exhaust system will exhaust all bathrooms and janitors' closets. These spaces will be exhausted at 2 CFM/sf. The exhaust will be ducted to the roof through the main building exhaust system.

An exhaust fan, ducting and controls will be provided for the electrical and mechanical rooms, exhausting through the roof. Fire dampers with access panels will be provided at fire wall and floor penetrations.

Air Handling Unit. The building will be served by one air handling unit (AHU). The AHU will have air side and water side components. The **water side** will contain a heat recovery/heating coil and an indirect evaporative cooling (tower water) coil. These coils will be designed for high water velocity and low air velocity.

On the **air side,** a low air velocity will reduce fan power requirements. Its airfoil centrifugal supply fan will have a premium-efficiency fan motor equipped with a variable frequency drive (VFD) and direct drive between motor and fan. The AHU will supply 100-percent outside air at all times. Downstream of the indirect evaporative cooling coil, a direct evaporative cooling section will use high-pressure fog nozzles supplied with deionized water through a booster pump.

Central Plant HVAC System

The **Central Cooling Plant** will incorporate the following mechanical equipment, along with associated piping, accessories and controls.

Cooling Tower. The draw-through cooling tower will have a premium efficiency fan motor and a VFD. The cooling tower will be sized for a low approach temperature. When the AHU is in cooling mode, the cooling tower fan will draw the building exhaust air through the tower, reducing supply water temperature to the AHU indirect evaporative cooling coil. A water-treatment system will be included.

Tower Water Pumps. Two tower water pumps (one main and one standby) will be sized and selected to pump water through the cooling tower, piping, and the indirect evaporative cooling coil. The main pump will be high-efficiency, with a premium efficiency motor and a VFD. The standby pump will be a standard-efficiency pump and (constant-speed) motor.

The **Central Heating Plant** will have the following mechanical equipment, with associated piping, accessories and controls:

Gas-fired boilers. The heating plant will consist of a pair of gas-fired condensing boilers, which will use water from the heat recovery coil as a preheater. In weather conditions requiring a smaller amount of heat, the heat-recovery water will be used directly in the AHU heating coil.

Pumps. Two heating hot water (HHW) and two heat-recovery water pumps (each having one main and one standby) will be sized and selected to pump water, through, respectively, (1) the boiler, piping, and the AHU heating coil and (2) the heat-recovery coils, and piping. The

main pumps will be high-efficiency and equipped with premium efficiency motors and VFDs. The standby pumps will be standard-efficiency pumps and (constant speed) motors.

Expansion tank and filter feeder. A diaphragm type expansion tank and filter ("pot") feeder assembly will be provided for the HHW and heat recovery system. This will allow for system water expansion and contraction as the water temperature changes, and will provide for water treatment.

Control System

The HVAC and water heating system will be monitored and selected additional points controlled and/or monitored by a comprehensive direct digital control (DDC) system. The DDC system will become part of the existing sitewide Facility Monitoring and Control System.

Plumbing

Hot and Cold Water Systems. Each restroom, janitors' closet, and lunch room will be provided with cold water and with hot water through a gas-fired condensing water heater for sinks and shower. A domestic hot water heat exchanger will use drain water from the shower and sinks to preheat the incoming cold water. Hot water piping will be traced with electric tracing and heavily insulated.

Sanitary Waste and Vent System. Waste and vent systems will be installed for all restrooms, janitors' closets, and lunch rooms. The waste system will extend to the existing site sanitary sewer system.

Fixtures. Water coolers will be installed on each floor. Lavatories, urinals and water closets will be installed per the California Plumbing Code (CPC). Wall hung units will be acceptable. Automatic (infrared) actuated flushing systems and waterless urinals will be employed if they are life-cycle cost-effective.

Roof Drainage System. A roof drainage system will be connected to the site storm water system and possibly to cisterns for irrigation.

Fire Protection Systems

The design of the fire protection systems for the Research Support Building will conform to the NFPA National Fire Codes.

Sprinkler System. The systems will be supplied from the existing site distribution system through a cross-connection control assembly. The riser assembly will contain a pumper connection, tamper switches and a flow switch. These switches will tie into the fire alarm system. The system will be an Ordinary Group II wet pipe system covering the entire interior of the building.

Smoke Control System. A smoke control system will exhaust the space that is producing smoke and pressurize adjacent spaces. This system will have a centrally located indication and control panel for Fire Department use in emergencies.

2.6 Electrical Design

The design of electrical systems for the Research Support Building will conform to the California Electrical Code (CEC).

Building Power Supply. Electrical power to the building will be supplied from the existing Building 2 switchgear 238A which is rated at 480/277V, 3-phase 60Hz. The 480/277V power feeder to the main power panel in the Building 59 electrical room will run through existing conduits from Building 2 Room 129C to EMH-150. New conduits will be installed from EMH-150 to Building 59. The building will be served by 480Y/277 and 208Y/120 volt distribution systems, with branch circuit panels and step-down transformers located in dedicated electrical rooms on each floor.

The Research Support Building electrical distribution equipment will include:

- 480Y/277 volt, 3-phase, 4-wire distribution system, including panel boards, branch circuits panels, and step down transformers.
- A 480 volt, 3-phase, 3-wire motor control center will feed motors for building utilities, such as fans, air-conditioning, compressors and pumps.
- 208Y/120 volt, 3-phase, 4-wire distribution system, including panel boards, branch circuits in conduit and floor ducts , receptacles, and control wiring.
- 277 volt lighting system, including panel boards and branch circuit breakers and lighting control system.
- General lighting fixtures in offices, corridors, conference rooms will be 2’ x 4’ fluorescent fixtures with acrylic, prismatic lenses, high-frequency electronic ballasts, and compact fluorescent downlights.

Communications. Each floor of the building will have a communications closet from which telephone, communications, security system, and fiber-optic data circuits will be distributed.

Lighting. Lighting will be controlled from dedicated switches, occupancy sensors, and photocells. Lighting controls will be zoned and, where practical, integrated with the Facility Monitoring and Control System. Small offices will be individually switched and controlled with occupancy sensors. Where natural light is available, two-level switching or photocell controls will be utilized. Task lighting will be provided where required. Indirect lighting illumination will be provided to reduce glare where required.

Photovoltaic System/Emergency Lighting. A solar photovoltaic system, integral to the roofing system, will be provided with backup from the normal power source. This will serve as a charging system to the emergency lighting and egress system in the building. Emergency lighting will be provided in corridors, stairwells and other public areas by connecting selected fixtures of the general lighting system to emergency power circuits.

Ground System. The building ground system will consist of a perimeter grounding grid, utilizing driven ground rods with interconnecting copper cable. All building steel, interior metallic piping, equipment grounds and separately derived electrical power system neutrals will be bonded to this grounding grid.

Data Circuits. The building will be equipped with telephone, communications, security, and fiber optics data circuits. Within the building, the wireways and raceways will be run to office areas of the building from local communications closets.

Paging System. Raceways and wiring for the paging system equipment, intercom cables, and speakers will provide the Laboratory public address system to all building areas.

Fire Alarm System. A complete building fire alarm system with extensions to the existing Laboratory wide fire alarm system will be provided. Each floor will be on a separate water flow zone and critical equipment will be shut down automatically upon actuation of its zone. Smoke detection will be provided in areas where required. Bells, manual pull stations, strobe lights for the hearing impaired; local annunciation as well as connection to the hill-wide LBNL fire alarm system will be provided. ELD exit signs will direct egress from the building.

Access Control System. Card access security will control all building entries.

2.7 Applicable Codes and Design References

Applicable requirements and recommendations in the following codes and references will be followed in the design. These codes, as listed, should be included in the construction specifications. Codes and references will be the latest editions except where specifically noted otherwise:

1. California Building Code (CBC)
2. California Electrical Code (CEC)
3. California Mechanical Code (CMC)
4. California Administrative Code, Title 20, Chapter 2, Subchapter 4, Article 1, Building Efficiency Standards and the Compliance Requirements of Title 24, Part 2, Chapter 2-53 (Title 24)
5. California Plumbing Code (CPC)
6. California Energy Code (CEC)
7. California Fire Code (CFC)
8. California Health and Safety Code
9. California Code of Regulations; Title 8, Title 19
10. NFPA National Fire Codes
11. NFPA 70, National Electrical Code
12. National Electrical Safety Code, ANSI C2
13. Occupational Safety and Health Act (OSHA)
14. General Services Administration 41 CFR Part 101-19
15. Americans with Disabilities Act (ADA)
16. Energy Conservation Performance Standards, 10 Code of Federal Regulations (CFR), Part 435 (Mandatory for Federal Buildings)
17. Occupational Safety and Health Standards, 29 CFR Part 1910, Department of Labor
18. Safety and Health Regulations for Construction, 29 CFR Part 1926, Department of Labor
19. Environmental Protection Agency, 40 CFR Parts 264 and 265
20. American National Standards Institute (ANSI) Standards
21. The American Society of Heating and Air Conditioning Engineers (ASHRAE) Handbooks and Standards
22. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Standards
23. American Institute of Steel Construction (AISC) Manual of Steel Construction

24. American Concrete Institute (ACI) Manual of Concrete Practice; Parts 1 through 5
25. LBNL Long Range Site Development Plan
26. Factory Mutual Engineering Corp. (FM) Approval Guide and Loss Prevention Data Sheets
27. Underwriters' Laboratories, Inc. (UL) Standards and "Building Materials, Fire Protection Equipment, and Fire Resistive Directories"
28. Lawrence Berkeley Laboratory Health and Safety Manual, Publication 3000
29. "Lateral Force Design Criteria", RD3.22 of LBNL Design Management Procedures Manual
30. Life Cycle Costing Manual for the Federal Energy Management Program, National Institute of Standards and Technology, Handbook 135
31. LBNL Energy Conservation Report Specifications

2.8 Quality Assurance Procedures for Design, Construction, Facility Acceptance and Project Closeout

Quality assurance procedures during project development, design, and construction assure that all safety, operational and Subcontract requirements will be met. The established system to review, inventory, and document facility construction, acceptance, and project closeout includes the following elements:

Engineering

The Berkeley Lab Facilities Department, assisted by selected consultants, provides quality control and assurance measures during design and construction.

The Architecture and Engineering Group of the Facilities Department includes multidisciplinary design and project management sections. Each significant project is assigned to a Project Manager (PM) who is responsible for the management of cost, scope and schedule. The PM is also responsible for quality assurance during project formulation and implementation, and is assigned a staff that includes a design coordinator (the Technical Coordinator, or TC), a multidisciplinary design support team, a construction manager if necessary, a contract administrator, and a construction inspector. The TC is responsible for design and technical quality control. The work of each member of the TC's support team is reviewed by the appropriate discipline Section Chief. The PM develops a Project Execution Plan that is reviewed and approved by Facilities Management and DOE/BSO.

Design and cost estimates are reviewed, and a plan check is carried out by Berkeley Lab, at completion of schematics and during and after Title I and Title II designs are completed. An independent third party plan check is made of the seismic design, and an independent cost estimate is made by a consulting cost estimator at completion of Title I and Title II to compare with the A&E's cost estimate. Plans and specifications are also reviewed by the Berkeley Lab Fire Marshal, the Berkeley Lab Environment, Health and Safety (EH&S) Division, the Berkeley Lab Energy Conservation Engineer, and the Berkeley Lab Facilities Maintenance and Operations Group at each stage of design development. When applicable, a consulting geotechnical firm provides appropriate geotechnical data and reviews the design at each stage of design and during construction.

An internal sign-off sheet covering all Berkeley Lab design disciplines, TC, PM, Fire Marshal, EH&S, Facilities Management, and the Client is completed at the end of Title II. (A sample form follows.)

Construction

Subcontract documents are reviewed by Berkeley Lab's technical staff for compliance with DOE and Berkeley Lab design criteria.

The Construction Inspector reviews, and the Executive Architect and Engineer (A&E of Record) and Facilities' staff of engineers accept or reject, all materials and workmanship in accordance with Subcontract documents.

A submittal control system for materials, shop drawings, test reports, and certifications assures that all necessary reviews have been made for compliance with specifications, codes, environmental mitigation measures and other requirements—including provisions for the handicapped and energy conservation.

A Construction Inspector observes construction activities and reports discrepancies to Berkeley Lab's Project Manager (or Construction Manager, if applicable) and the TC. Daily inspection reports are maintained in a file or a project logbook.

A Contract Administrator (from the Purchasing Department) reviews documentation for compliance with Subcontract provisions.

A Safety Inspector (from Berkeley Lab's Environment, Health and Safety Division) and the Fire Marshal make periodic inspections of construction to assure compliance with safety and fire codes and regulations.

Specialty inspections are made of rebar, structural steel, welding, concrete, and geotechnical conditions to assure compliance with codes and specifications. Appropriate testing laboratories are utilized for support as necessary. The A&E of Record is required to inspect the construction during appropriate times and provide interpretation of the Subcontract documents whenever necessary.

Subcontract Change Orders

The Berkeley Lab A&E team and Executive Architect and Engineer review any proposed change and provide justification and an independent cost estimate. The Subcontractor's proposed cost is evaluated relative to Berkeley Lab's cost estimate, and a Subcontract price is negotiated. Availability of project funds is verified. If all project and Subcontract requirements are met, a Change Order is executed.

Final Inspection and Acceptance

The following items are accomplished by the Inspector and the A&E of Record working together:

- Preliminary inspection and list of incomplete work.
- Equipment testing and operational instruction of Berkeley Lab personnel.
- Final inspection walk-through and punch list.
- Inspection of correctional and completion work (punch list work).
- Inventory of all operational manuals, instructions, guarantees.
- Internal sign-off sheet: Acknowledgment of completion and acceptance of all work under construction Subcontract by the PM, Inspector, Client and Facilities Management.

Project Closeout

After final acceptance of the facility, Berkeley Lab audits all charges to assure that all costs are in proper accounts. Berkeley Lab sends the cost closing statement to DOE/BSO. Project authorization is closed by DOE/BSO.

PROJECT PLAN REVIEW
(LINE ITEM & GP PROJECTS)

Project Title

Job Number | Subcontract No/PB No | Documents Prepared by

☐ **FINAL DESIGN** (Title II - Construction Documents)

Title II signatures confirm that Plan Review[1] has been performed, construction documents are complete, ready for construction, signed, stamped, and comply with applicable codes. Signatures also confirm that administrative and engineering controls to prevent and mitigate environmental, safety and health hazards have been incorporated into the design.

☐ **DRAWINGS**

☐ **SPECIFICATIONS**

		FINAL DESIGN
1. Architectural Section Chief	Print Name	Signature/Date
2. Structural Section Chief	Print Name	Signature/Date
3. Mechanical/IHEM Section Chief	Print Name	Signature/Date
4. Electrical Section Chief	Print Name	Signature/Date
5. EH&S Coordinator	Print Name	Signature/Date
6. Fire Marshal	Print Name	Signature/Date
7. Maintenance Manager (O&M)	Print Name	Signature/Date
8. Client or Occupant	Print Name	Signature/Date
9. Facilities Project Manager	Print Name	Signature/Date

Copy completed form to Deputy Facilities Manager.

[1]See "Plan Review Manual" (ICBO, 1994) for definitions, legal implications and limitations of plan reviews.

PROJECT CONSTRUCTION COMPLETE REVIEW
(LINE ITEM & GP PROJECTS)

Project Title

Job Number | Subcontract No/PB No | Documents Prepared by

☐ **CONSTRUCTION COMPLETE** (Title III - Construction Administration)
Title III signatures confirm that construction has been completed in accordance with construction documents, complies with applicable codes, and as-built drawings have been completed.

☐ **BENEFICIAL OCCUPANCY**

☐ **KD4**

		CONSTRUCTION COMPLETE
1. Inspector	Print Name	Signature/Date
2. EH&S	Print Name	Signature/Date
3. Fire Marshal	Print Name	Signature/Date
4. Client	Print Name	Signature/Date
5. Project Manager	Print Name	Signature/Date

3. Cost Estimate

The cost estimate for the construction was prepared by Davis Langdon Adamson, professional estimaters and reviewed by John Eastman, a Berkeley Lab Facilities Department professional estimator.

3.1 Basis of Cost Estimate

The estimate is based upon quantity and component take-offs from conceptual design drawings and specifications.

The cost estimate is dated February, 2002, and represents current prices. Summary cost estimate information is included in this section. The detailed cost estimate is included in Section 9. Escalation is based upon "Anticipated Economic Escalation Rates for DOE Construction Projects" updated January, 2001 namely 2.6% in FY 2002, 2.8% in FY2003, 2.8% in FY2004, 2.9% in FY2005, and 2.9% in FY2006. Escalation rates are compounded from February, 2002 to the midpoint of construction, May, 2006.

Cost estimate details for ED&I are located at the end of Section 9. Both the Estimate Summary shown in this section and the Detailed Cost Estimate in Section 9 have been correlated with the Work Breakdown Structure (WBS) shown in the BA/BO Schedule.

04-LBNL, Research Support Building
Lawrence Berkeley National Laboratory, Berkeley, California

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2003 Budget Request *(Preliminary Estimate)*	1Q2004	3Q2005	4Q2005	2Q2007	$15,000	$15,265

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2004	1,600	1,600	980
2005	12,600	12,600	2,750
2006	600	600	7,520
2007	200	200	3,750

4. Details of Cost Estimate[a]

	(dollars in thousands) Current Estimate
Design Phase	
Preliminary and Final Design costs (Design Drawings and Specifications)	1,029
Design Management costs (2.3 % of TEC)	345
Project Management costs (1.0 % of TEC)	150
Total, Design Costs (10.2 % of TEC)	1,524
Construction Phase	
Building	9,840
Inspection, design and project liaison, testing, checkout and acceptance	586
Project Management (3.0 % of TEC) [b]	450
Total, Construction Costs	10,876
Contingencies	
Design Phase (2.1 % of TEC)	320
Construction Phase (15.2 % of TEC)	2,280
Total, Contingencies (17.3% of TEC)	2,600
Total, Line Item Costs (TEC)	15,000

[a] This cost estimate includes design phase activities only. Construction activities will be requested as individual line items on completion of Title I design. The annual escalation rates assumed in the FY 2004 estimate for FY 2002, FY 2003, and FY 2004 are 2.6, 2.8, and 2.8 respectively.
[b] Includes Construction Management costs.

RESEARCH SUPPORT BUILDING
CONSTRUCTION COST ESTIMATE SUMMARY ($k)

1	Foundations		829
2	Vertical Structure		437
3	Floor & Roof Structures		668
4	Exterior Cladding		1,067
5	Roofing & Waterproofing		411
6	Interior Partitions, Doors & Glazing		239
7	Floor, Wall & Ceiling Finishes		274
8	Function Equipment & Specialties		1,016
9	Stairs & Vertical Transportation		277
10	Plumbing Systems		151
11	Heating, Ventilating & Air Cond.		632
12	Electrical & Communications		715
13	Fire Protection Systems		104
14	Site Preparation & Demolition		44
15	Site Paving & Landscaping		401
16	Utilities on Site		259
Subtotal Direct Cost			7,524
General Conditions/Mobilize		9%	677
Safety Program Mgmt (~2.5% of Labor Cost)			94
Estimating Contingency			*In Project Contingency*
Bond		1.5%	113
Prime Contractor OH & Fee		4%	328
Total Estimated Construction Cost at February, 2002			8,736
Total Escalation to Midpoint of Construction in May, 2006		12.25%	1,070
Subtotal Escalated Construction Cost			9,806
Berkeley Lab Overhead			30
Construction Cost			$9,836
SAY			**$9,840**

RESEARCH SUPPORT BUILDING

SECTION 3

ESCALATION ANALYSIS

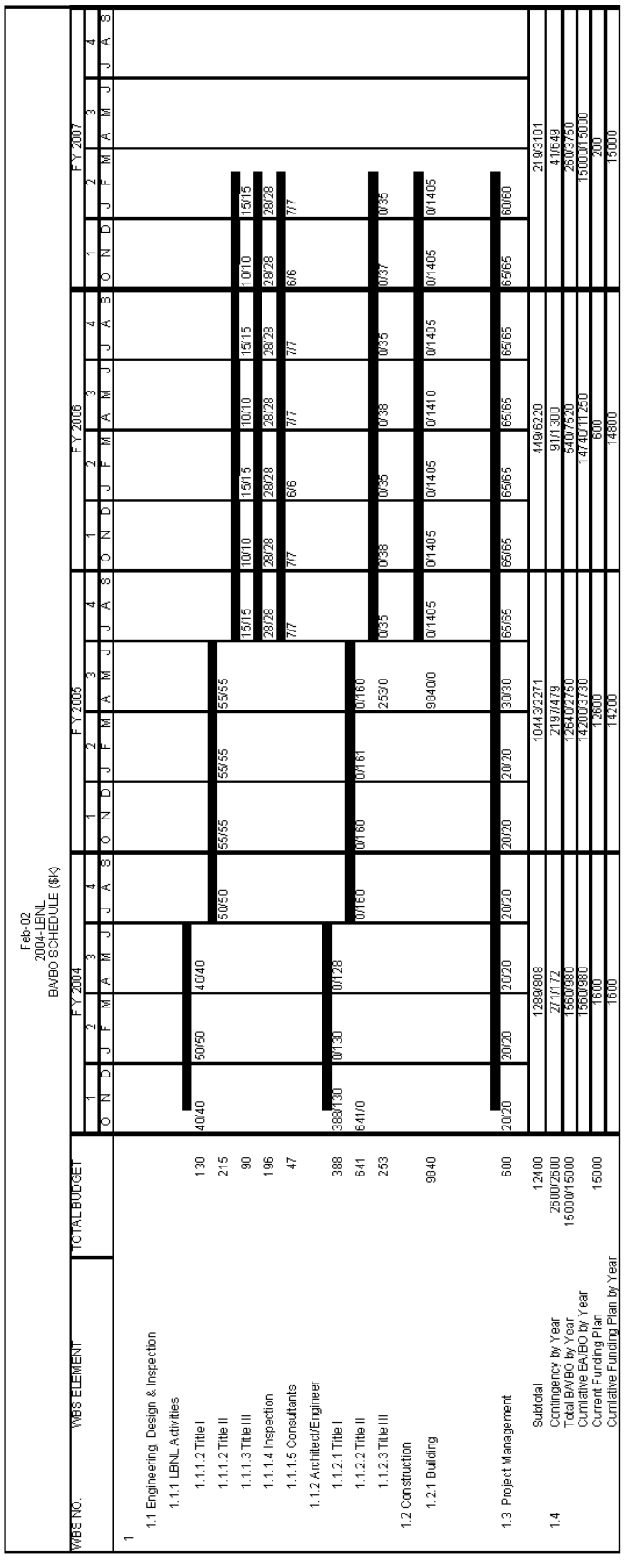
Based on DOE "Anticipated Economic Escalation Rates" (updated January 2001)

Start Construction:	July 2005
Construction Period:	20 Months
Finish Construction:	March 2007
Midpoint Construction:	May 2006
Latest Estimate:	February 2002

										%
FY	2002	Feb	2002	-	Sep	2002	7	mo	@	2.6	=	1.5
FY	2003	Oct	2002	-	Sep	2003	12	mo	@	2.8	=	2.8
FY	2004	Oct	2003	-	Sep	2004	12	mo	@	2.8	=	2.8
FY	2005	Oct	2004	-	Sep	2005	12	mo	@	2.9	=	2.9
FY	2006	Oct	2005	-	May	2006	7	mo	@	2.9	=	1.7

Total Compounded Escalation 12.25%

RESEARCH SUPPORT BUILDING



RESEARCH SUPPORT BUILDING

CONTINGENCY ANALYSIS

	Estimated Cost ($K)	Contingency (%)	Contingency ($K)
LBL Activities			
Engineering	435	25	109
Inspection	196	10	20
Consultants	47	10	5
Architect/Engineer			
Titles I & II	1,029	20	206
Title III	253	15	38
Construction			
Buildings	9,840	22	2,162
Project Management	600	10	60
Subtotal	12,400		2,600
Contingency ~21%	2,600		
TOTAL	15,000		

MAJOR COMPONENTS OF COST ESTIMATE ($K)

Fabrication Rate 18.5% Procurement ($0,-$500k) 5.0%

		Base Cost	Escalated @ 12.25%	Overhead/ Burden	Cost	Rounded
A.	**ED & I**	1,631	1,831		1,961	1,960
	1) ENGINEERING & DESIGN (IN HOUSE)	515	578	101	679	
	Title I	98	110	20	130	
	Title II	162	182	34	215	
	Title III	68	76	14	90	
	Inspection	147	165	31	196	
	Consultants	40	45	2	47	
	2) ENGINEERING & DESIGN (A/E)	1,116	1,253	30	1,282	
	Title I	338	379	9	388	
	Title II	558	626	15	641	
	Title III	220	247	6	253	
B.	**Construction**	8,736	9,806	30	9,836	9,840
	Building	8,736	9,806	30	9,836	
C.	**Project Management**	451	506	94	600	600
	SUBTOTAL (A, B, & C)	10,818	12,143	254	12,397	12,400
	CONTINGENCY (~21%)					2,600
	TOTAL ESTIMATED COST (TEC)					**15,000**

DOE Construction Project and Operating Expense
Escalation Rate Assumptions
(as of January 22, 2001)

Fiscal Year	Energy Research and Nuclear		Fossil		Conservation and Solar		Defense Programs and Gen. Constr.		Environmental Management*		Operating Expenses	
	Index	Percent	Index	Percent	Index	Percent	Index	Percent	Index	Percent	Index	Percent
2001	1.000	2.5	1.000	2.5	1.000	2.5	1.000	2.3	1.000	2.6	1.000	2.1
2002	1.026	2.6	1.026	2.6	1.025	2.5	1.024	2.4	1.027	2.7	1.021	2.1
2003	1.054	2.8	1.053	2.7	1.051	2.6	1.052	2.8	1.054	2.7	1.042	2.1
2004	1.082	2.8	1.081	2.8	1.078	2.7	1.081	2.9	1.082	2.8	1.063	2.1
2005	1.111	2.9	1.109	2.8	1.105	2.7	1.111	2.9	1.110	2.8	1.084	2.1
2006	1.140	2.9	1.138	2.9	1.133	2.8	1.140	3.0	1.139	2.9	1.105	2.1
2007	1.174	3.0	1.171	2.9	1.165	2.8	1.174	3.0	1.171	2.9	1.128	2.1

* "Environmental Restoration" column changed to "Environmental Management" and the "Waste Management" column has been eliminated. Dual escalation rate structure is obsolete for how EM operates currently.

Note: Based on the materials and labor data contained in the Energy Supply Planning Model and appropriate escalation rates forecasted, it would be expected that DOE projects conform to those rates shown. It is recommended that any local rates different from those above be submitted to the Office of Engineering and Construction Management for approval prior to their use. Additional advice and assistance can be obtained from the Director of Office of Engineering and Construction Management 202-586-4027

4. Project Time Schedule

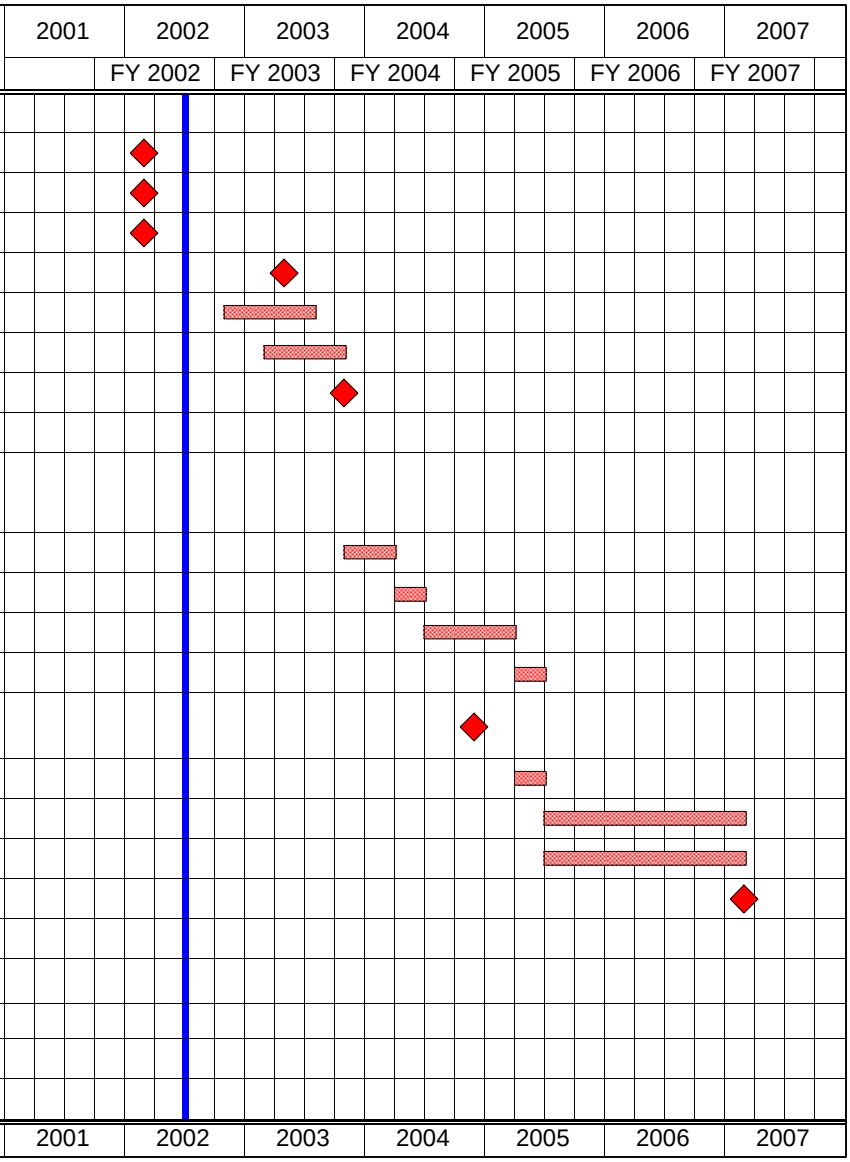
4.1 Basis of Project Time Schedule

The Project Time Schedule that follows is based upon the following assumptions:

- PED funding will be made available for commitments by Berkeley Lab on January 1, 2004 and funding for construction will be available on January 1, 2005.
- Berkeley Lab will evaluate environmental conditions and prepare recommendations for NEPA documentation for DOE consideration beginning in November 2002 with completion by August 2003. A categorical exclusion recommendation is anticipated for this project.
- A/E selection will take place between March and September 2003, during which time the Design Program necessary for A/E fee negotiations will be completed.
- A/E fee negotiations will take place between September and November 2003 contingent upon assurance by DOE that PED funding for this project is in the FY 2004 budget.
- Alternative solutions including environmental considerations have been carefully studied in the process of developing this conceptual design, thus it is anticipated that the existing solution will be specified for A/E design.

Research Support Building
Time Schedule

Activity Name	Start Date	Finish Date
CD-0	2/28/02	
Submit PED	3/1/02	
Submit CDR	3/1/02	
CD-1	5/1/03	
NEPA / SARS	11/1/02	8/1/03
A/E Selection	3/1/03	11/1/03
PED Funds Available	11/1/03	
Design & Construction		
Title I Design	11/1/03	3/30/04
CD-2	4/1/04	7/1/04
Title II Design	7/1/04	4/1/05
CD-3	4/1/05	7/1/05
Construction Funds Available	12/1/04	
Bid & Award	4/1/05	7/1/05
Title III Services	7/1/05	3/1/07
Construction	7/1/05	3/1/07
CD-4	3/1/07	



5. Schedule of Project Drawings

T-1 Location Plan
T-2 Existing Site Plan
T-3 Site Plan
A-1 First Level Plan
A-2 Second Level Plan
A-3 Third Level Plan
A-4 Fourth Level Plan
A-5 Roof Plan
A-6 Building/Site Sections
A-7 Exterior Elevations
S-1 Foundation Plan
S-2 Second Level Framing & Foundation Plan
S-3 Third & Fourth Level Framing Plans
S-4 Roof Framing Plan
S-5 Structural Frame Elevations
S-6 Structural Frame Elevations
U-1 Mechanical – Site Utilities
U-2 Electrical—Site Utilities
M-1 HVAC Riser Diagram
M-2 Plumbing Riser Diagrams
M-3 Fire Protection Riser Diagrams
E-1 Single-Line Diagram
E-2 Single-Line Diagram

6. Outline Specifications

Division 0	NOT APPLICABLE	
Division 1	GENERAL REQUIREMENTS	
	01505	Construction Waste Management
	01060	Regulatory Requirements
	01200	Project Meetings
	01300	Submittals
	01400	Quality Control
	01510	Temporary Utilities
	01525	Construction Aids
	01530	Barriers
	01590	Field Offices and Sheds
	01900	Lateral Force Anchorage Provisions
Division 2	SITE WORK	
	02060	Demolition
	02200	Earthwork
	02410	Tieback Anchors
	02510	Asphalt Paving
	02600	Pipe Utility Systems
	02605	Manholes
	02710	Site Drainage
	02780	Underground Electrical Utilities
	02810	Landscape Irrigation
	02920	Soil Preparation
	02950	Trees, Plants and Ground Cover
Division 3	CONCRETE	
	03100	Concrete Formwork
	03200	Concrete Reinforcement
	03250	Concrete Accessories
	03300	Cast-In-Place Concrete

Division 5	METALS	
	05120	Structural Steel and Miscellaneous Metal
	05310	Steel Deck
	05400	Cold Formed Metal Framing
	05510	Metal Stairs
Division 6	WOOD AND PLASTICS	
	06410	Custom Casework
Division 7	THERMAL AND MOISTURE PROTECTION	
	07140	Wateproofing Elevated Deck
	07210	Building Insulation
	07270	Firestopping
	07465	Preformed Metal Siding
	07525	Modified Bitumen Roofing
	07900	Sealants
Division 8	DOORS AND WINDOWS	
	08110	Steel Doors and Frames
	08520	Aluminum Windows
	08710	Door Hardware
	08800	Glazing
Division 9	FINISHES	
	09110	Metal Stud Framing System
	09260	Gypsum Board System
	09310	Ceramic Tile
	09510	Suspended Acoustical Ceilings
	09650	Resilient Flooring
	09680	Carpet
	09900	Painting
Division 10	SPECIALTIES	
	10100	Visual Display Boards
	10160	Metal Toilet Compartments
	10210	Metal Wall Louvers
	10270	Access Flooring
	10400	Identification Devices
	10800	Toilet and Bath Accessories
Division 11	EQUIPMENT	
	11030	Audio-Visual Equipment
	11050	High Density Mobile Storage

Division 12	FURNISHINGS	
	12510	Horizontal Louver Blinds
Division 13	SPECIAL CONSTRUCTION	
	13650	Photovoltaic System
Division 14	CONVEYING SYSTEMS	
	14200	Elevators
Division 15	MECHANICAL	
	15250	Mechanical Insulation
	15300	Fire Protection
	15400	Plumbing
	15500	Heating, Ventilation and Air Conditioning
	15975	Facility Monitoring and Control System
	15990	Testing, Adjusting and Balancing
Division 16	ELECTRICAL	
	16010	Basic Electrical Requirements
	16110	Conduit
	16114	Cable Trays
	16120	Wire and Cable
	16121	Medium Voltage Cable
	16122	Low Voltage Wire and Cable (24V or Less)
	16130	Boxes
	16141	Wiring Devices
	16311	Outdoor Type Secondary Unit Substation
	16361	Air Interrupter Switches
	16363	SF6 Gas Insulated Switches
	16450	Secondary Grounding
	16460	Dry Type Transformers
	16470	Panelboards
	16480	Motor Control Centers
	16483	Variable Frequency Drives
	16500	Lighting
	16700	Communications
	16721	Fire Alarm Detection Systems
	16727	Security Access System
	16915	Lighting Control System

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01505: CONSTRUCTION WASTE MANAGEMENT

A. General Waste Management Goals

1. Employ construction processes which generate the least amount of waste possible.

2. Reuse, salvage, or recycle as many of the waste materials as economically feasible.

3. Minimize waste disposal in landfills.

B. Waste Diversion Goals

1. Establish goals for new construction, demolition and major remodeling, and interior remodeling.

C. Waste Management Plan

1. Submit a Waste Management Plan prior to removal of any waste.

D. Progress Reports

1. Submit regular Waste Management Progress Reports including:

a. Amount of material landfilled and identity of landfill site.

b. Amount of material recycled, reused, or salvaged and the receiving party.

SECTION 01060: REGULATORY REQUIREMENTS

A. Codes and Design References

1. Codes listed in Section 2 should be included in the construction specifications; codes and references shall be latest editions except where specifically noted otherwise.

2. Design Standards

a. Earthwork

1) Standard Specification, State of California, Department of Transportation, Division of Highways.

2) ASTM Standards for compaction.

b. Concrete

1) ACI-318 Building Code Requirements for Reinforced Concrete.

2) ACI-347 Recommended Practice for Concrete Formwork.

3) CRSI Manual of Standard Practice.

c. Concrete Reinforcement

4) ACI-301 Specification for Structural Concrete for Buildings.

5) ACI-315 Manual of Standard Practice for Detailing Reinforced Concrete.

6) ACI-318 Building Code Requirements for Reinforced Concrete.

7) CRSI 59 Recommended Practice for Placing Reinforcing Rods.

8) CRSI 63 Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

9) ASTM Standards.

10) AWS D12.1 Reinforcing Steel Welding Code.

d. Structural Steel

11) AISC Standard Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.

12) AISC Code of Standard Practice for Steel Buildings and Bridges.

13) AWS Structural Welding Code D1.1.

14) AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.

15) ASTM Standards.

16) SSPC Steel Structures Painting Council.

e. Metal Decking

1) Steel Deck Institute - SDI Standard #1.

2) AISI Specification for the Design of Light Gauge, Cold Formed, Steel Structural Members.

3) American Welding Society Standards.

SECTION 01200: PROJECT MEETINGS

A. Preconstruction conference.

B. Billing meetings, at the last progress meeting each month.

C. Periodic progress meetings, twice each month.

D. Guarantees, bonds, and service and maintenance Subcontracts meetings.

SECTION 01300: SUBMITTALS

A. Schedules

1. Progress schedule.

2. Proposed cash-flow schedule.

3. Schedule of values.

4. Submittal schedule.

B. Product list.

C. Shop drawings, product data, and samples.

D. Certificates of compliance.

SECTION 01400: QUALITY CONTROL

A. Soils engineer's services.

B. Testing laboratory's services.

C. Testing agency's services.

SECTION 01510: TEMPORARY UTILITIES

A. Provide the following temporary utilities as part of the work of this Subcontract:

1. Heat and ventilation.

2. Sanitary facilities.

3. Telephone service.

4. Fire protection.

B. Water will be provided by the University.

SECTION 01525: CONSTRUCTION AIDS

A. Provide the following construction aids as part of the work of this Subcontract:

1. Construction elevators and hoists.
2. Temporary enclosures.
3. Swing staging.
4. Scaffolding and platforms.

SECTION 01530: BARRIERS

A. Fences.

B. Tree and plant protection.

C. Barricades.

D. Erosion control.

SECTION 01590: FIELD OFFICES AND SHEDS

A. Field offices and sheds may be specially constructed for the work of this Subcontract, or they may be portable or mobile buildings.

SECTION 01900: LATERAL FORCE ANCHORAGE PROVISIONS

PART 1 SCOPE

1.01 WORK INCLUDED

A. This section establishes the criteria for the design and installation of seismic supports and anchorage for non-structural components.

1.02 DRAWINGS AND SPECIFICATIONS

A. The Subcontractor/Vendor is responsible for the design of the anchorage of non-structural components which are not specifically detailed on the subcontract documents. All designs shall be produced by the Subcontractor/Vendor's registered engineer and reviewed/approved by the University.

1.03 CRITERIA

A. Seismic anchorage of conventional equipment designed for any location on the LBNL site shall be designed for a Type A seismic source, as defined in the CBC, for locations less than 2 km from the source. Seismic anchorage designed for location at other sites shall be in accordance with the requirements of the local building official.

B. Seismic anchorage of program equipment and non-conventional equipment shall be designed in accordance with chapter 23 of PUB-3000.

C. The minimum wind speed shall be 75 mph and the minimum value of C_e, as defined in the CBC, shall be 14.5 psf with type C exposure, as defined in the CBC..

DIVISION 2 - SITE WORK

SECTION 02060: DEMOLITION

PART 1 SCOPE

1.04 WORK INCLUDED

A. Demolition work shall include saw cutting and removal of existing concrete, pavement, footings and underground utilities.

1.05 EXECUTION

A. Demolition shall be conducted in a safe and timely manner. All material shall become the property of the Subcontractor and shall be promptly removed and properly disposed of offsite.

SECTION 02200: EARTHWORK

PART 1 GENERAL

1.01 WORK INCLUDED

A. Earthwork shall include all excavation, fill, and backfill, as well as site mobilization. Work also encompasses fine grading for pads and walls, street coarse preparation, backfilling of trenches, foundations, and retaining walls, and placement of base materials for slabs on grade and roadways.

B. All earthwork and related testing shall conform to ASTM standards.

C. Testing will be done by an independent laboratory subcontracted by the Lawrence Berkeley National Laboratory.

D. Shoring and lagging shall be the responsibility of the Subcontractor.

PART 2 PRODUCTS

2.01 MATERIALS

A. Base material under slabs on grade and roadways shall be Class 2 aggregate base/subbase, conforming to specifications of the State of California Division of Highways.

B. Backfill behind all retaining walls shall be pervious materials.

C. All backfill shall be nonexpansive material, free of deleterious materials and large rocks. Materials of suitable composition excavated on site may be utilized as backfill material when approved.

PART 3 EXECUTION

A. All fill and backfill shall be compacted to 90% maximum density unless noted; 95% maximum density will be required in paved and improved areas.

B. All temporary and finished cut slopes shall be configured as recommended by a Geotechnical Engineer familiar with the site geology.

C. Backfill shall be compacted by impact and/or vibration methods.

SECTION 02410: TIEBACK ANCHORS

PART 1 GENERAL

1.01 APPLICATION

A. This specification applies to tieback anchors in applications such as tieback retaining walls and establishes the quality level for corrosion protection of pre-stressing steel.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pre-stressing steel: Deformed grade 150K anchors conforming to ASTM A-722.

B. Polymer sheathing for permanent anchors:

1. A heat shrink sleeve which meets ASTM D.

C. Cement grout shall be Type II conforming to ASTM C-150.

PART 3 EXECUTION

3.01 Installation procedure

A. Drilling

1. Drill holes for the tiebacks at the locations indicated in the plans.

2. Drilling equipment shall be suitable for the strata encountered.

3. Grout tiebacks at the lowest point of the tieback after installation of tieback.

B. Continue excavating to the next tieback (if any) and repeat the above procedure.

SECTION 02510: ASPHALT PAVING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work includes all new paving and patch paving for roadways, pathways, curbs, roadside swales, and access driveways.

B. Materials, including paving materials, shall conform to the Standard Specifications of the State of California, Division of Highways.

PART 2 PRODUCTS

2.01 MATERIALS

A. Asphalt concrete surfacing shall consist of a 50mm minimum layer of Type B aggregate 85-100% penetration, steam-refined asphalt.

B. Penetration prime coat, asphalt paint binder, and seal coat shall conform to the standard specifications.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Batching, placing, and compacting of asphalt concrete surfacing shall conform to the standard specifications.

SECTION 02600: PIPE UTILITY SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Underground water distribution piping relocation and extension to the new facilities.

B. Sanitary sewer piping relocation and extension to the new facilities.

C. Natural gas piping relocation and extension to the utilities building.

1.02 RELATED WORK

A. Storm drainage system relocation and extensions.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Water Distribution System: Ductile iron with rodded and clamped joints with cross connection control.

B. Sanitary Sewer Piping: Cast iron soil pipe.

C. Natural Gas System: Polyethylene (PE) plastic pipe with pressure reducing station and earthquake shutoff valve.

SECTION 02605: MANHOLES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Manholes and handholes for below-ground electrical and telephone service.

PART 2 PRODUCTS

2.01 MATERIALS

A. Precast reinforced concrete boxes, sectional type manholes, and handholes for underground service, complete with cast iron cover, neck, ladders, cable racks and traffic lids shall conform to ASTM C-478 specifications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install manholes on a 150mm base of crushed rock. Backfill around manholes shall be compacted sand to allow for drainage.

SECTION 02710: SITE DRAINAGE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work includes concrete-lined interceptor trench drains, installation of perforated pipe subsurface drains, erosion control sedimentation traps and basins, storm-water inlet structures and junction boxes, and all storm-water conduits.

PART 2 PRODUCTS

2.01 MATERIALS

A. Perforated pipe shall be PVC with 25% minimum recycled post consumer industrial plastic.

B. Catch basins, field inlet, and junction boxes shall be cast-in-place units. Precast units may be substituted as specified on the plans or as approved by the engineer. All lids and grading will sustain H-20 wheel loading for boxes susceptible to such loading.

C. Storm drain shall be schedule 80 PVC drainage piping with 25% minimum recycled post consumer industrial plastic. Storm-water piping at depths greater than 1.2m or contained within a private street right of way shall be reinforced concrete pipe.

SECTION 02780: UNDERGROUND ELECTRICAL UTILITIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish all labor supervision, materials, equipment, tools, transportation, and services required to disconnect, provide temporary services, install, tie in, relocate, and test existing high-voltage electrical/telephone conduits and related appurtenances.

PART 2 PRODUCTS

2.01 MATERIALS

A. New duct banks and related appurtenances.

B. Manholes and junction boxes.

C. Conduit.

D. Transmission cable as specified in Division 16, Electrical.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Existing electrical/telephone conduit systems shall be relocated or adjusted to grade per the Lawrence Berkeley National Laboratory Standard Specifications.

SECTION 02810: LANDSCAPE IRRIGATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe and fittings, valves, outlets, bubblers, and accessories.

B. Connection to utilities.

C. Control system.

1.02 SYSTEM DESCRIPTION

A. Electric solenoid controlled underground irrigation system, with drain.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe: PVC or ABS.

B. Outlets: Bronze.

C. Spray Type Sprinkler Head: Pop-up head.

D. Water-saving.

SECTION 02920: SOIL PREPARATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Final grade topsoil for finish landscaping.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Use topsoil from on-site.

SECTION 02950: TREES, PLANTS AND GROUND COVER

PART 1 GENERAL

1.01 WORK INCLUDED

A. Trees.

B. Plants.

C. Ground cover.

DIVISION 3 - CONCRETE

SECTION 03100: CONCRETE FORMWORK

PART 2 PRODUCTS

2.01 MATERIALS

A. Reusable Formwork: Steel, fiberglass reinforced plastic or wood forms, re-usable site assembled.

B. Form Sealer: Nonbonding and nonstaining.

C. Form Accessories: Standard types, as required.

SECTION 03200: CONCRETE REINFORCEMENT

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: ASTM A615, Grade 400.Recycled Content: 100% total recycled content containing a minimum of 75% post consumer steel.

B. Welded-Wire Fabric: ASTM A185 or ASTM A497.

C. Tie Wire: No. 16 AWG or heavier, black annealed.

D. Spirals: ASTM A82.

SECTION 03250: CONCRETE ACCESSORIES

PART 2 PRODUCTS

2.01 MATERIALS

A. Expansion-Joint Fillers

1. Exposed Joints: ASTM D1751.

2. Sealed Joints: ASTM D1752.

B. Water Stops: Preformed polyvinyl chloride, "Hydrocide Vinylstop," manufactured by Sonneborn-Contect, or equal.

SECTION 03300: CAST-IN-PLACE CONCRETE

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement Concrete

1. Compressive Strength, 28-day minimum

a. All concrete: 30 Mpa.

2. Portland Cement: ASTM C150, Type II.

3. Aggregates: ASTM C33. Coarse aggregates shall be recycled, locally sourced, crushed concrete aggregate subject to approval by Structural Engineer

4. Water: Clean and potable.

5. Admixtures: ASTM C494 or C290, as approved. Fly ash made from 100% post consumer waste stream materials

B. Concrete Curing

1. Liquid Membrane-Forming Compound: ASTM C309, Type I.

2. Sheet Materials: ASTM C171.

3. Clean, nonstaining burlap.

C. Patching Mortar: Concrete materials, except with coarse aggregate omitted.

D. Grout

1. Non-metallic: Concrete materials, except with coarse aggregate omitted.

2. Metallic Nonshrink: "Embeco 153," manufactured by Master Builders, or approved equal.

PART 3 EXECUTION

3.01 PLACEMENT AND CURING

A. Place concrete in accordance with ACI 301.

B. Cure freshly placed concrete until concrete has reached its 28 day strength.

C. Testing will be done by an independent laboratory selected by the Lawrence Berkeley Laboratory.

DIVISION 5 - METALS

SECTION 05120: STRUCTURAL STEEL AND MISCELLANEOUS METAL

PART 2 PRODUCTS

2.01 MATERIALS

A. All structural steel and miscellaneous metal, unless otherwise specified: ASTM A36/A572. Structural steel recycled content: 100% minimum total recycled content containing a minimum of 75% post consumer steel.

B. Pipe: ASTM A53, Type S, Grade B.

C. High-Strength Bolts: ASTM A325.

D. Standard Bolts and Nuts: ASTM A307, Grade A.

E. Washers for Standard Bolts: ANSI B27.2 and B27.4.

F. Welding Electrodes: E70.

G. Welding: Shielded-arc method.

H. Galvanizing

1. Structural shapes and plates: ASTM A123.

2. Hardware and threaded components: ASTM A153.

I. Primer: Solvent-based, inorganic zinc paint.

SECTION 05310: STEEL DECK

PART 2 PRODUCTS

2.01 MATERIALS

A. One and one half inch (1 1/2") deep x three foot (3'-0") wide corrugated steel sheet conforming to ASTM A446, zinc coated , hot-dipped galvanizing, Grade A. Recycled content 28% minimum total recycled content containing a minimum of 16% post consumer steel.

SECTION 05400: COLD FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Load bearing formed steel stud exterior wall, and interior wall, framing.

B. Formed steel slotted channel, framing and bridging.

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

A. Studs: ASTM C955, formed to channel shape, punched web, 1.2 mm thick.

2.02 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined

2.03 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A123, hot dip galvanized to 380 gm/sq m.

B. Welding: In conformance with AWS D1.1 and AWS D1.3.

PART 3 EXECUTION

3.01 ERECTION OF STUDDING

A. Install components in accordance with manufacturer's instructions.

B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 600 mm o.c.

C. Place studs at 400 mm o.c.; not more than 50 mm from abutting walls and at each side of openings.

SECTION 05510: METAL STAIRS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Metal fabrications, miscellaneous metal, and related accessory. The work includes, but is not limited to, the following:

1. Concrete filled steel pan stair treads and steel risers.

2. Steel handrails, brackets, and sockets.

PART 2 PRODUCTS

A. Stair Framing

B. Metal Pan Units

C. Stair Railings and Handrails

PART 3 EXECUTION

3.01 INSTALLATION

A. Install steel stair units in accordance with the approved shop and erection drawings, and with the manufacturer's instructions.

DIVISION 6 - WOOD AND PLASTICS

SECTION 06410: CUSTOM CASEWORK

PART 1 GENERAL

1.01 WORK INCLUDED

A. Special fabricated cabinet units.

B. Countertops.

C. Cabinet hardware.

1.02 QUALITY ASSURANCE

A. Perform work in accordance with Woodwork Institute of California Standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cabinet Work: Flush overlay design. Plastic laminate on all exposed surfaces. Interior surfaces and edges to be finished with "Guardian Liner" or acceptable alternate.

B. Use wood only from well-managed forests, salvaged wood, and products manufactured from waste wood such as old pallets or agriculturally based raw materials such as wheat.

2.02 CABINET HARDWARE

A. Hinges.

B. Shelf Brackets.

C. Drawer and Door Pulls.

D. Catches.

E. Drawer Slides.

PART 3 EXECUTION

2.01 INSTALLATION

A. Secure cabinet to floor and wall using appropriate angles and anchorages.

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

SECTION 07140: ELEVATED DECK WATERPROOFING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Fully bonded elastomeric waterproof coating at elevated roof decks.

1.02 WORK IN OTHER SECTIONS

A. Concrete slabs finish deck: 03300, Cast-In-Place Concrete.

B. Tapered insulation: 07210, Building Insulation

1.03 SYSTEM DESCRIPTION

A. Two component, synthetic rubber, cold vulcanized, fluid applied monolithic waterproofing membrane.

PART 2 PARTS

2.01 MANUFACTURERS

A. Grace Construction Products.

2.01 MATERIALS

A. “Procor 75 Spray Grade” for horizontal and vertical applications.

B. “Procor 10 Pourable Grade” for horizontal applications.

C. “Procor 20 Trowel Grade” for vertical applications.

D. “Procor Reinforcement Mesh.”

E. “Hydroduct 660” geocomposite drainage sheet.

SECTION 07210: BUILDING INSULATION

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Owens Corning

B. Certainteed

C. Rock Wool Manufacturing

2.02 MATERIALS

A. Inorganic glass-fiber or mineral-fiber blankets, foil-faced.

B. Polystyrene insulation board, tapered.

C. Recycled content, CFC and/or HCFC-free, and water based urethane foam or cementitious foam.

SECTION 07270: FIRESTOPPING

PART 2 PRODUCTS

2.01 MATERIALS

A. Safing Insulation: FS HH-I-521, Type I.

B. Fire-Rated Foam: DOW Corning #3-6548, G.E. "RTV 850," or approved equal.

C. Exposed fasteners, sheet metal flashing, wall caps, and trims shall have finish matching wall panels.

D. Framing: Structural-steel studs, galvanized.

E. Sheathing: 16 mm (5/8 inch) Type X gypsum wallboard on exterior and interior faces.

F. Insulation: Fiberglass batts, R-14 minimum.

SECTION 07465: PREFORMED METAL SIDING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Preformed metal siding, related flashings and accessory components.

1.02 SYSTEM DESCRIPTION

A. Preformed galvanized steel building panel system with 2½" corrugated profile.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. BHP Steel Building Products USA, Inc.

2.02 MATERIALS

A. Exterior wall panels, 24 ga steel with Zincalume Plus coating. Recycled content.

B. Internal and External Corners: Same material, thickness and finish as exterior sheets, profile to suit system to maintain continuity of profile. Recycled content.

C. Trim, Closure Pieces, Caps, and Flashings: Same material, thickness and finish as exterior sheets; brake formed to required profiles. Recycled content.

2.03 FINISH

A. Unpainted.

SECTION 07525: MODIFIED BITUMEN ROOFING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Insulation, membrane roofing and base flashings.

1.02 SYSTEM DESCRIPTION

A. Modified Bitumen Conventional Roofing System: Two-ply mineral surface cap sheet membrane system over rigid insulation.

PART 2 PRODUCTS

2.01 MANUFACTURERS - MEMBRANE MATERIALS

A. Garland Company.

B. Tarmac Roofing, Inc.

2.02 MATERIALS

A. Membrane: Asphalt and polymer modifiers (APP) A60+MILS.

B. Sheet Materials: Polyester felts; asphalt saturated and coated inorganic base sheet.

C. Bituminous Materials: Asphalt bitumen; asphalt primer.

D. Base Flashings: Flexible sheet flashing, modified bitumen; asphalt impregnated wood fiberboard fiber cant and tapered edge strips.

E. Insulation: Roof deck rigid insulation, tapered.

F. Surfacing: Mineral cap sheet, light gray color.

SECTION 07900: SEALANTS

PART 2 PRODUCTS

2.01 MATERIALS

A. General Exterior Building Sealing: Two-component gun-grade, non-sag, rubber-based elastomeric; FS TT-S-00227E, Type II, Class A. Sika "Sikaflex-la", Mameco "Vulkem 116", or equal.

B. Traffic-Bearing Horizontal Surfaces: Two-part puncture-resistant polyurethane, durometer hardness 25 to 50 after 14 days.

C. Interior Building Sealing, Except as Otherwise Specified: Single-component gun-grade, paintable acrylic-latex water-based; WOODMONT "Chem-Calk 600" or approved equal. Tremco "Acrylic Latex," Pecora "AC-20," or equal.

D. Acoustical Sealing: Permanently plastic non-skinning paintable synthetic-polymer-based; PRESSTITE "No. 579.64 Acoustical Sealant" or approved equal. W.W. Henry "Sound Control Sealant" No. 313B, or equal.

E. Sanitary Sealing: FS TT-S-001543A, Class A single-component primerless, flexible, mildew-resistant silicone rubber; DOW-CORNING "Dow-Corning Silicone Rubber Bathtub Caulk," Catalog no. 8640, or approved equal.

F. Sealant Backup: Compatible with sealant material.

G. Sealant VOC (volatile organic compounds) Content Limits: Follow Bay Area Air Quality Management District guidelines.

DIVISION 8 - DOORS AND WINDOWS

SECTION 08110: STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Hollow metal doors.

B. Rolled steel frames.

C. Interior light frames.

D. Louvers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steelcraft

B. Fenestra

C. Forderer

2.02 MATERIALS

A. Doors: Flush construction, formed steel sheets, 1.3 mm (18-gage) thick.

B. Frames: Cold or hot rolled sheet steel, 1.6 mm (16-gage) thick. One piece welded construction.

C. Finish: Baked-on primer; baked enamel finish.

D. Recycled content, R-value.

SECTION 08520: ALUMINUM WINDOWS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Extruded aluminum windows with operating sash.

B. Glass and glazing.

C. Operating hardware and insect screens.

1.02 SYSTEM DESCRIPTION

A. Windows with top hinged outward projecting sash.

B. Exterior glazing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Blomberg.

B. Fentron.

2.02 MATERIALS

A. Extruded aluminum.

2.03 FINISHES

A. Factory applied resinous coating.

SECTION 08710: DOOR HARDWARE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Hardware for wood and hollow metal doors.

B. Thresholds.

C. Gasketting.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schlage.

SECTION 08800: GLAZING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Glass and glazing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pittsburgh Plate Glass; Azurlite

B. Libbey-Owens-Ford Co; Evergreen or similar

C. Southwall Technologies SC75 or similar

2.02 MATERIALS

A. Float glass.

B. Safety glass fully tempered.

C. Solar control glass: double paned supplied with low emissivity coatings and a minimum of one-half inch space, argon-filled.

D. U-Value: less than 0.3.

E. Heat Gain Coefficient (SHGC): less than 0.58 balance with Visible Transmittance.

F. Visible Transmittance: above 0.65.

G. Glazing Luminous Efficacy (Ke): more than 1.

DIVISION 9 - FINISHES

SECTION 09110: METAL STUD FRAMING SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Formed metal stud framing.

B. Framing accessories.

1.02 SYSTEM DESCRIPTION

A. Metal stud framing for exterior wall infill, recycled content.

B. Metal stud framing system for interior walls, recycled content.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dale Industries.

B. United States Gypsum.

SECTION 09260: GYPSUM BOARD SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Gypsum board.

B. Taping and joint treatment.

1.02 SYSTEM DESCRIPTION

A. Acoustic attenuation interior partitions.

B. Fire rated interior partitions and shaft walls.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. United States Gypsum.

B. New West Gypsum.

2.02 MATERIALS

A. Gypsum board, 16 mm (5/8 inch) thick.

B. Fire rated gypsum board, 16 mm (5/8 inch) thick.

C. Moisture resistant gypsum board, 16mm (5/8 inch) thick.

D. Recycled content, product take back.

SECTION 09310: CERAMIC TILE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Ceramic tile floor and base finish using the setting bed method.

B. Ceramic tile wall finish using the thin set method.

C. Thresholds at door openings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daltile

B. Terra Green

C. Tile Cera

2.02 MATERIALS

A. Ceramic floor tile.

B. Ceramic wall tile.

C. Cove base to match floor tile.

D. Recycled content.

SECTION 09510: SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Suspended metal grid ceiling system.

B. Acoustical tiles and panels.

C. Lateral bracing of ceiling system.

D. Perimeter trim.

PART 2 PRODUCTS

2.01 MANUFACTURERS - SUSPENSION SYSTEM

A. Donn Products.

B. Chicago Metallic.

2.02 MANUFACTURERS - ACOUSTICAL TILE

A. Armstrong

B. Celotex

C. United States Gypsum

2.03 MATERIALS – ACOUSTICAL TILE

A. Recycled content, product take back.

SECTION 09650: RESILIENT FLOORING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Resilient sheet and tile flooring.

B. Resilient base.

C. Resilient stair nosings, treads and risers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Forbo Industries

B. DLW Gerbert

C. Ipocork

2.02 MATERIALS

A. True Linoleum Sheet Flooring.

B. True Linoleum Tile Flooring.

C. Natural Cork Flooring.

SECTION 09680: CARPET

PART 1 GENERAL

1.01 WORK INCLUDED

A. Carpeting—roll goods and carpet squares.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Collins & Aikman

B. Interface

C. Image

2.02 MATERIALS

A. Dry, pre-applied adhesives; if wet adhesives must be used, specify low VOC.

B. Recycled content, product take back.

SECTION 09900: PAINTING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Surface preparation.

B. Surface finish schedule.

C. Color selection schedule.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pratt and Lambert.

B. Fuller O'Brien.

C. ICI

2.02 MATERIALS

A. Low or no VOCs, recycled content.

DIVISION 10 - SPECIALTIES

SECTION 10100: VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Liquid chalkboards.

B. Tackboards.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Forbo Industries, Bulletin Board.

2.02 MATERIALS

A. Tackboard: solid linoleum.

B. Liquid Chalkboards: Enamel coated steel.

SECTION 10160: METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Metal toilet compartments, ceiling hung.

B. Urinal screens, wall mounted.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Accurate Partitions

B. Santana Solid Plastics

C. Weis Robart Partitions

2.02 MATERIALS

A. Steel, baked enamel finish.

B. Hardware: Chrome plated nonferrous cast pivot hinges, gravity type, adjustable for door close positioning.

C. Recycled plastic or recycled cardboard content cores.

SECTION 10210: METAL WALL LOUVERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Louvers and frames.

B. Bird and insect screens.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Airolite.

B. Construction Specialties, Inc.

2.02 MATERIALS

A. Louvers and Frames: Extruded aluminum, factory applied resinous coating.

B. Screens: Interwoven aluminum wire mesh, factory applied vinyl coating

SECTION 10270: ACCESS FLOORING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Access flooring panels.

B. Support understructure.

C. Supply registers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tate Access Floors, Inc.

B. USG "Donn Access Floor System."

2.02 MATERIALS

A. Bolted stringer understructure support system - 8 inch clear space.

B. Steel floor panels.

C. Carpet covered under section 09680.

D. Directable floor registers for air supply.

SECTION 10400: IDENTIFICATION DEVICES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Site Signage.

B. Building Signage.

C. Room Signage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Studio L'Image

2.02 MATERIALS

A. Laboratory standard signs per LBNL Signage and Public Information Standards, Ver. 4 1999.

SECTION 10800: TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Toilet and washroom accessories, recessed.

B. Attachment hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bobrick

B. Scott

2.02 MATERIALS

A. Stainless Steel Sheet: ASTM A167, Type 304.

B. Tubing: Stainless steel.

C. Plastic.

2.02 FINISH

A. Stainless Steel: Satin luster finish.

DIVISION 11 – SPECIAL EQUIPMENT

SECTION 11030: AUDIO VISUAL EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Directors Conference Room AV equipment.

B. Multi-purpose room AV Equipment.

C. Teleconference room AV & Videoconferencing Equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Barco

B. Extron

C. Sony

D. PictureTel

E. Ascend

2.02 MATERIALS

A. AV System

1. LCD projector with motorized zoom lens and ceiling mount kit.
2. Switcher system with universal computer interface and necessary cables.
3. VCR.
4. TV tuner with rack mount.
5. Document camera.
6. Mixer/amplifier with rack mount and input module.
7. Ceiling speakers with hardware.
8. Touch panel with necessary cables and interfaces.
9. Equipment rack.
10. Power conditioner

B. Videoconferencing System

1. Teleconferencing system.
2. Multiband VSX with cables.

3. Scan converter.
4. Modem.
5. Video monitors.
6. Cart.

SECTION 11050: HIGH DENSITY MOBILE STORAGE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Mobile high density storage units for library shelving.

B. Computer control system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Spacesaver Corp

B. Nordplan USA

2.02 MATERIALS

A. End panels will be of metal construction. End panel assembly will consist of individual sections capable of being mounted in a stacking manner and attached to end gables. Individual end panel sections must allow for replacement in the event of damage during usage or change in interior color scheme. Each end panel assembly to include a black kick plate at floor level.

B. Each carriage must be equipped with microprocessing units providing at least 64K of RAM. All electronic and microprocessing components must be accessible by use of door in carriage front panel without the need for end panel disassembly. All carriage microprocessors must be equipped with RS232 communication components for remote carriage control, adjustment, and programming. All carriage microprocessors must provide LCD display on carriage end panel.

C. Automatic Weight Adjustment. System must be capable of recognizing changes in the weight of media stored on a carriage and be capable of adjusting drive and safety systems to maintain consistent operation.

D. Mobile to Stationary Programming. Each carriage must be capable of conversion from stationary to mobile operation and back by use of the keypad and on the end panel.

E. Adjustable Stopping Distances. Each carriage must be capable of adjustable stopping distances in its travel in both right and left directions. The adjustments must be able to be made by use of the keypad with no requirement for "range finders" or other mechanical stopping devices.

F. Security Access Coding. Each carriage must be capable of programming up to fifteen individual access codes to limit access to classified material. Code programming and code revisions must be programmable from the individual carriages or from a remote controller location. System must be capable of "security alert" to advise system manager that unauthorized access has been attempted.

G. Safety Systems. Mobile system must offer as manufacturer's standard the capability of a three level safety system without the use of safety floors or safety sweeps. Safety System must provide that carriage movement can be controlled by the use of block buttons on either side of an open aisle. Block buttons must be released prior to the new aisle opening. Block button system must be capable of being deactivated without affecting the remaining safety system levels. Safety System must enable users to stop moving carriages by applying 50 pounds of pressure against any part of the moving carriage or storage components (i.e., shelving). Safety system must be self-monitoring to render a carriage inoperable in the event of safety system component malfunction within that carriage. System to include an aisle surveillance system capable of detecting a human presence anywhere within the cubic air space of an open aisle. When the presence is detected, all carriages within that established grouping must be automatically rendered inoperable while the aisle is occupied. When the aisle is vacated, the system must return to a fully operable state in no more than 5 seconds. The system must be programmable so that entrance to an opening aisle will not cause the system to become inoperable prior to the opening aisle completing its opening sequence.

H. PC Interface. All carriages must be capable of receiving commands from a PC through the use of standard computer cable and RS232 connectors. All carriage movement, adjustments and security must be controllable from a remote PC location.

I. Environmental Interface. System must be capable of controlling lighting within its location to turn room lighting on and off at programmed time intervals. System must offer as an option a filtration system to remove airborne particulates within the system area.

DIVISION 12 - FURNISHINGS

SECTION 12510: HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Horizontal slats louver blinds.

B. Mounting accessories.

C. Operating hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Levolor.

2.02 MATERIALS

A. Louvers: Aluminum one-inch wide horizontal slats, factory-applied plastic coating finish.

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13650: PHOTOVOLTAIC SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install complete photovoltaic system for generating and providing electricity to the building's electrical system. System to include roof-mounted array of photovoltaic modules, inverter to convert DC power to AC, isolation transformer, all necessary overcurrent, lightning, and ground-fault protection to meet relevant CEC, UL, and IEEE requirements, and all required conduit and wire to provide a fully functional system.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND MATERIALS

A. Photovoltaic modules to be mounted directly on flat roof. Powerguard modules manufactured by Power Light Corporation, or equal.

B. Inverter designed for photovoltaic systems and three-phase grid-tie application. Inverter shall be capable of automatic synchronization with the utility power, shall automatically disconnect the PV system on loss of utility power, and shall use peak power point tracking to maximize electrical output. Xantrex/Trace Engineering PV Series, or equal.

DIVISION 14 - CONVEYING SYSTEMS

SECTION 14200: ELEVATORS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Elevator Types:

1. Service/Passenger: Traction, 1,814 kilogram (4,000 lbs) capacity, four stops.

B. Elevator cars with two doors.

C. Hoistway entrances.

D. Penthouse and hoistway equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Montgomery-KONE Inc: EcoSystem MR AC Gearless Elevator, no known equal.

2.02 MATERIALS

A. The Hoisting Machine shall be an EcoDisc® AC gearless hoisting machine including an axial synchronous permanent magnet drive motor, direct current electro-mechanical brake and integral traction drive sheave.

DIVISION 15 - MECHANICAL

SECTION 15250: MECHANICAL INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Piping insulation.

B. Ductwork insulation.

1.02 RELATED SECTIONS

A. Section 07210: Building Insulation.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Building Piping Insulation: All heating water systems shall be insulated with fiberglass insulation, and all cooling water systems shall be installed with closed-cell foam insulation as necessary to comply with applicable energy conservation standards.

B. Ductwork Insulation: All exterior supply ductwork shall be lined with insulation to reduce heat transfer and reduce noise transfer. All interior ductwork shall be lined with hard surfaced insulation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

SECTION 15300: FIRE PROTECTION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Fire protection piping.

B. Wet Pipe Sprinkler System.

C. Standpipe and Hose Systems.

1.03 RELATED SECTIONS

A. Section 02660: Pipe Utility Systems.

B. Section 16721: Fire Alarm and Detection Systems.

PART 2 PRODUCTS

2.01 COMPONENTS

All components shall be FM or UL listed.

A. Sprinklers and Piping.

B. Valves and cross connection Control.

C. Water Flow Switches.

D. Fire Department connection.

PART 3 EXECUTION

3.01 INSTALLATION

A. Fire protection systems shall be hydraulically calculated. The systems shall be installed and tested by a licensed contractor.

SECTION 15400: PLUMBING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Plumbing Piping.

B. Plumbing Specialties.

C. Plumbing Fixtures.

D. Plumbing Equipment.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Sanitary sewer waste and vent piping. Cast iron no-hub type fittings.

B. Roof drainage piping. Cast iron no-hub type fittings.

C. Domestic cold water piping. Soldered copper tubing.

D. Cross connection control devices. Listed devices shall be used.

E. Natural Gas Piping (Utility Building Only): Black steel threaded pipe.

F. Water Heater: Common natural-gas equipment with condensing heat exchanger. Heat exchanger for wastewater heat recovery.

G. Plumbing Fixtures: Porcelain wall hung with chrome trim and per below:

1. Urinals: No-Flush™ Waterless Urinal, Waterless Co.

H. Drinking Water Coolers: Insulated electric type.

PART 3 EXECUTION

3.01 INSTALLATION

A. All systems shall be installed and tested in conformance with the Uniform Plumbing Code.

SECTION 15500: HEATING VENTILATION AND AIR CONDITIONING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Basic mechanical materials.

B. Heat Transfer Equipment.

C. Refrigeration Equipment.

D. Air Handling Equipment.

E. Air Distribution Equipment.

1.04 RELATED WORK

A. Section 15975: Facility Monitoring and Control System.

B. Section 15990: Testing, Adjusting and Balancing.

SECTION 15975: FACILITY MONITORING AND CONTROL SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and Install

1. Building Automation System.

2. Software.

1.05 RELATED SECTIONS

A. Section 15990: Testing, Adjusting, and Balancing

B. Section 16915: Lighting Control System

1.06 SYSTEM DESCRIPTION

A. The purpose of the project is control and monitor the operation of specific heating, ventilating, and air conditioning (HVAC) and water heating systems. The means of accomplishing this is through the installation of a fully distributed processing Building Automation System (BAS) with both supervisory control and Direct Digital Control (DDC) capabilities for automation of building energy-using systems, including heating, ventilation, air conditioning, and by monitoring specific room lighting "occupancy sensors" to control the operation of the HVAC in those spaces.

B. The BAS shall be a fully independent programmable control system with full energy monitoring control and data acquisition capabilities, and remote communications capability for remote programming, monitoring, manual override, remote alarm indication and logging, and automatic collection and processing of historical data. Text-based and graphics screens shall be provided for access at existing operator workstations.

PART 2 PRODUCTS

2.01 FMCS MANUFACTURER

A. Johnson Controls Metasys™, to match existing, provided and installed by the Subcontractor.

PART 3 EXECUTION

3.01 FMCS INSTALLATION

A. The Subcontractor shall install one or more field processing units (FPUs) and any required input/output interface devices, all in appropriate enclosures. Subcontractor shall provide and install all appropriate appurtenances, devices and terminate wiring from the input/output subsystem and shall perform a comprehensive acceptance inspection and test, and prove connection and function for all input/output subsystem components. The FMCS Subcontractor shall develop, install, test, tune and prove, and thoroughly document all applications programs.

3.02 FMCS FIELD SERVICES

A. Perform a comprehensive acceptance inspection and test of all installation details and system operational validity, including but not limited to; inspection and verification of input/output sensor locations, control device location and connection, input/output point terminations, point-by-point proof of function for each input/output, and functional test of all application software.

SECTION 15990: TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Testing, adjustment, and balancing of HVAC systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Demonstration of Mechanical Equipment.

D. Mechanical System Startup and Commissioning.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Test, adjust, and balance the following components:

B. Gas-Fired Absorption Chiller/Heater.

C. Heating Water and Chilled Water Coils.

D. Evaporative Coolers.

E. Cooling Tower.

F. Pumps.

G. Air Handling Unit.

H. Fans.

I. Heat Recovery Equipment.

J. Terminal Units (Supply and Return).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install instrumentation and test, adjust and balance in accordance with AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.

DIVISION 16 - ELECTRICAL

SECTION 16010: BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL SCOPE

A. New electrical duct bank for 15kV power feeders from existing electrical manhole to a new manhole

B. New electrical duct bank from the new unit substation to the new electrical manholes.

C. Two (2) new 15kV gas insulated sectionalizing switches and one (1) new unit substation for feeding new building.

D. 480Y/277 volt and 208Y/120 volt distribution panels and interior power distribution system.

E. Electrical system, equipment and building grounding.

F. Motor control center and wiring to mechanical equipment.

G. Interior and exterior lighting, including emergency egress lighting.

H. New communications duct bank containing cables and raceways for the Integrated Communication System (ICS), fire alarm, security and monitoring systems, Energy Monitoring and Control (EMCS) and the hill-wide public address system.

I. Building fire protection and hazard alarm systems with remote annunciation at the Lawrence Berkeley Laboratory fire station.

J. Conduit and wiring for local Energy Monitoring and Control System with a connection to the Lawrence Berkeley Laboratory hill-wide system.

K. All electrical equipment shall be tested prior to energization.

SECTION 16110: CONDUIT

PART 1 GENERAL SCOPE

A. Interior conduits, installed concealed whenever possible: ¾” nominal electrical metallic tubing (EMT).

B. Conduit in floor slab or under floor: 1” nominal hot-dip galvanized, rigid steel with corrosion protection.

C. Power and communication branch circuit conduits, below grade: Underwriters' Laboratories, Inc. (UL) listed, Plastic, Carlon PVC, schedule 40, 1” conduit size, Concrete encased, 3” minimum all sides, with rebar reinforcement. Power and communications ducts shall be separated by 24”.

D. Power and communication within open office areas will be distributed by Walker Duct imbedded within the concrete floor and floor receptacles for feeds to office panels.

SECTION 16120: WIRE AND CABLE

PART 1 GENERAL SCOPE

A. Conductors for interior electrical systems shall be solid copper, No. 12 AWG minimum size for power and lighting branch circuits. Use solid No. 14 AWG for motor control wiring. Substitution with the stranded wires in lieu of the solid conductor type shall use approved termination fittings. Use solid conductor, No. 16 AWG for security, paging and fire alarm.

B. No. 8 AWG and larger: Class B stranded copper.

C. Wire Types:

1. Power and lighting conductors shall be 600 volt, XHHW or THHN.

2. Bonding and grounding conductors shall be ASTM B1, solid, bare copper for sizes No. 8 AWG and smaller, and shall be ASTM B8 Class B stranded copper for sizes No. 6 AWG and larger.

SECTION 16121: MEDIUM VOLTAGE CABLE

PART 1 GENERAL SCOPE

A. 15kV Class (133% Insulation level) shielded power cable: Single conductor, jacketed, and insulated with a high quality, heat, moisture, impact, ozone, and corona resistant thermosetting (ethylene propylene) rubber, suitable for use in wet or dry locations in conduit, underground duct systems, direct burial, and aerial installations.

B. Conductor strand shield shall be a minimum 2.5 mil thick extruded semi-conducting material. A non-metallic semi-conducting tape shield is not acceptable.

C. Insulation shall be an ethylene propylene rubber compound rater at 90°C for normal operation, 130°C for emergency overload conditions, and 250°C for short circuit conditions.

D. The insulating shield shall consist of semi-conducting non-metallic, extruded covering directly over the semi-conducting covering.

E. A continuous, extruded, tight fitting, non-conductive, abrasion, moisture, heat, weather, solvent and flame resistant black chlorosulfonated polyethylene jacket shall be applied directly over the copper shielding tape.

F. Cable terminations shall be molded rubber type in kit form with stress cone, ground clamp, non-tracking rubber skirts, utilizing molded elastomer, wet process porcelain, pre-stretched, and heat-shrinkable terminations utilizing factory preformed components. Terminations shall have a basic impulse level as required for the system voltage level.

G. Splice kits may be of the heat-shrinkable type, of the pre-molded splice and connector type, the conventional taped type, or the resin pressure-filled overcast tape type.

SECTION 16122: LOW VOLTAGE WIRE AND CABLE (24V OR LESS)

PART 1 – GENERAL SCOPE

A. General Purpose Communications Cables: Tinned copper, No. 22AWG minimum, solid, PVC insulated conductors; twisted pair; with an overall PVC jacket, NEC rated type CM. Jacket insulation shall be rated not less than 300 Volts and 80^{o}C.

B. Plenum Rated Communications Cables: Tinned copper, No. 22AWG minimum, solid, teflon insulated conductors; twisted pair; with an overall teflon jacket, NEC rated type CMP. The jacket insulation shall be rated not less than 300 Volts and 200^{o}C.

C. Monitoring and Control Cables: Copper conductor, 600V PVC insulation, rated 60°C; individual conductors twisted together, 100% shielded and covered with an overall PVC jacket. Minimum size shall be No. 18AWG.

D. Analog and Digital Signal Cables: Tinned copper, stranded, PVC insulated conductors; twisted pair or triad; 100% aluminum-polyester shield; with stranded, tinned copper drain wire; and an insulated overall jacket. Jacket insulation shall be rated not less than 300 Volts and 60°C. All single pair or triad signal cables shall be No. 18 AWG.

E. Relay Control and Monitoring Cables: Comply with the insulation requirements of the NEC Article 725. Conductors in sizes #18 and #16 shall be type TFFN. Minimum size shall be #18.

F. Tray cables: TC rated and installed in accordance with the requirements of NEC - 318.

G. Security Access System Cables: Similar to communication cables in "A" above, except the minimum size shall be No. 18 for lock power, No. 20 AWG for card reader and No. 22 AWG for alarm contact wiring.

SECTION 16130: BOXES

PART 1 – GENERAL SCOPE

A. Outlet Boxes: Galvanized Sheet Metal Outlet Boxes. 4"X4"X1.5", or larger boxes with covers and gaskets to suit installation conditions. Use type FS or FD cast metal outlets with cast metal covers and gasketed hinged door for the switches and receptacles. Attach support hangers to metal studs or ceiling support members with No. 10 sheet metal screws.

B. Pull and Junction Boxes: Provide screw type cover of the same size as the box for surface mount boxes, and screw type cover with ¾" side overlaps for the flush mount boxes.

C. Fiberglass Hand-holes for Underground Installations: Die-molded with pre-cut 6"x 6" cable entrance at center bottom of each side, and fiberglass weatherproof cover with nonskid finish.

SECTION 16141: WIRING DEVICES

PART 1 – GENERAL SCOPE

A. Wall Switches for Lighting Circuits and Motor Loads Under 1/2-hp: Heavy duty snap switch with toggle handle, rated 20 A and 120-277 VAC.

B. Pilot Light Type: [Lighted handle] [Pilot strap in adjacent gang].

C. Flush Switches: Rated 15A, 277VAC only quiet type, lever operated.

D. Receptacles: Face color ivory, except that receptacles served from isolated ground circuits shall be orange, emergency power receptacles red, and surge protected receptacles blue. NEMA Type with current and voltage rating to match application.

E. Floor Mounted Service Fittings: Satin aluminum housing with stainless steel plates for one surface mount duplex convenience receptacles and communication circuits.

F. Flush Covers for Duplex Convenience Receptacle and communication: Brass finish flush cover suitable for floor box, with duplex-flap opening. Provide brass carpet rings.

SECTION 16311: OUTDOOR TYPE SECONDARY UNIT SUBSTATION

PART 1 – GENERAL SCOPE

A. Incoming Line Section: Consisting of a 15kV rated primary fused three-pole load interrupter switch with a two (2) position selector switch; in a weatherproof, non walk-in metal enclosure with switch assembly directly connected to the Transformer Section. The load interrupters shall have spring charged, stored energy operator. Flex shaft type operator will not be acceptable.

B. Transformer Section: Cast Coil, air cooled, outdoor type transformer, AA/FA rated, close-coupled to both its Incoming Line Section and the Outgoing Low Voltage Distribution Section through flexible braided copper or flexible copper leaf bus.

C. Outgoing Low Voltage Distribution Section: With metal enclosed 480 Volt rated main and feeder circuit, draw-out power circuit breakers housed in a weatherproof, walk-in aisle type metal enclosures for indicated substations. Power circuit breakers shall be factory-assembled, electrically operated, low-voltage, draw out construction. Each breaker shall be equipped with electronic sensing, timing and tripping circuits for adjustable long-time pickup and delay, adjustable ground-fault pickup and delay, adjustable instantaneous pickup, adjustable short-time pickup and delay and zone interlocking between main and branch circuit breakers and I^2t settings. Ground fault sensing shall be integral with the circuit breaker.

D. Power Factor Correction Capacitor Bank: The power factor correction (PFC) equipment shall be a self-contained, automatically-controlled with manual override self, protecting capacitor bank in a separate NEMA-4 enclosure. The PFC equipment shall allow automatic or manual switching of the capacitor bank kVAR's in ten 50-kVAR steps from or to the bus for power factor correction. A separate low-voltage power circuit breaker will cable connect the PFC equipment to the unit substation bus.

SECTION 16361: AIR INTERRUPTER SWITCHES

PART 1 – GENERAL SCOPE

A. Outdoor, fused load-interrupter switch in series with the selector switch for off-load transfer of supply from one to the other of two incoming circuits. The transfer from one circuit to the other shall be made when both circuits are energized and the interrupter switch is open.

B. Fuses: The fuses shall be expulsion type with discharge filters to be mounted in a separate compartment within the switch unit and accessible through a hinged door mechanically interlocked with the interrupter switch.

SECTION 16363: SF_6 GAS INSULATED SWITCHES

PART 1 – GENERAL SCOPE

A. 15kV-rated Vault Style, weatherproof, Multi-way Load break Switch with SF_6 gas filled tank. Tank shall be 1/4" mild steel, welded lid, corrosion resistant, primed and painted with no external aluminum parts.

B. Cable Terminators for each switch entrance: Entrance terminators for rubber covered cable. Cable terminators shall be Universal bushing type for each way.

SECTION 16450: SECONDARY GROUNDING

PART 1 GENERAL SCOPE

A. Grounding System Resistance: Five (5) ohms.

B. Conforms to the requirements of ANSI/NFPA 70 and IEEE 142.

C. Provide service ground at main circuit breaker section of low-voltage switchgear.

D. Ground secondary neutral point of all transformers.

E. Provide building column and water main grounding.

F. Ground all electrical equipment enclosures.

SECTION 16460: DRY TYPE TRANSFORMERS

PART 1 GENERAL SCOPE

A. Dry Type Transformers: ANSI/NEMA ST 20; factory-assembled, air cooled dry type transformers with amorphous cores.

B. Insulation system and average winding temperature rise for rated kVA as follows:

Rating (KVA)	Class	Rise (degree C)
1 - 15	185	115
16-500	220	80

C. Winding Taps, Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

D. Winding Taps, Transformers 15 kVA and Larger: ANSI/NEMA ST 20.

SECTION 16470: PANELBOARDS

PART 1 GENERAL SCOPE

A. Bus and Hardware: Panelboards shall be completely factory assembled and equipped with the type, size and number of branch circuit breakers, arranged and numbered as shown on the panel schedule. Use of at least 100 ampere breaker-connecting bus straps and mounting hardware.

B. All multi-pole breakers shall be common trip. Minimum Short Circuit Rating: as shown on drawings.

C. Pre-installed locking devices shall be provided for locking each circuit breaker in the OPEN position, by means of a padlock.

D. Molded Case Circuit Breakers: Provide bolt-on type circuit breakers with integral thermal and instantaneous magnetic trip in each pole and common trip handle for all poles. Provide circuit breakers, UL listed as Type HACR, for air conditioning equipment branch circuits. Provide circuit breakers, UL listed as Type SWD, for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled.

E. The cabinet shall have full-length hinged outer door designed to expose the wiring raceways and breakers, when open. Another, inner hinged door shall expose breakers only, when open, making this a door-in-door construction. Both doors shall open to the right. When the outer door is open, all gutter space shall be exposed.

F. Main Distribution Panel Instruments: Provide one ammeter with phase selector switch, one voltmeter with phase selector switch, and one watt-hour Demand Meter.

SECTION 16480: MOTOR CONTROL CENTERS

PART 1 GENERAL SCOPE

A. Motor Control Centers: NEMA ICS 2; Class II, Type B.

B. Motor Starter Units: Plug-in combination starters with motor circuit protectors and electronic protection for overloads, phase loss, and ground faults.

C. Feeder Tap Units: Molded case thermal-magnetic circuit breakers.

D. Voltage Rating: 480 volts, three-phase, 4-wire system

E. Horizontal Bus: Copper, with a continuous current rating of 600 amperes. Include copper ground bus entire length of control center.

F. Vertical Bus: NEMA ICS 2; copper, 300 amperes minimum.

G. Integrated Equipment Short Circuit Rating: As specified on the construction documents.

SECTION 16483: VARIABLE FREQUENCY DRIVES

PART 1 GENERAL SCOPE

A. Furnish and install Variable Frequency Drive(s) (VFD) and provide all wiring and interconnection, applications programming, and start-up and test services to provide variable speed fan/pump operation. It is the Subcontractor's responsibility to determine if the existing fan/pump motor is suitable for operation with VFD control.

B. VFD Type: Saftronics FPS MagnaTek^{TM} GPD 506 Series, or Omron IDM Controls model P5.

C. The VFDs shall include on-board self-diagnostics and indicators for troubleshooting of all operational problems.

D. The VFDs shall be totally enclosed in either wall-mounted or free-standing enclosures.

SECTION 16500: LIGHTING

PART 1 GENERAL SCOPE

A. Interior and exterior lighting systems shall comply with the IES Lighting Handbook. Lighting energy requirements shall conform to the DOE Energy Conservation Manual.

B. Emergency Lighting Units

1. Electroluminescent exit sign lights with battery backup.

2. Fluorescent egress lighting.

C. Fluorescent fixtures shall have specular reflectors, acrylic lenses and high-frequency electronic ballasts.

D. Provide task lighting, where required.

E. Provide combination ultrasonic infrared occupancy sensors in restrooms and office spaces.

SECTION 16700: COMMUNICATIONS

PART 1 GENERAL SCOPE

A. Extend the Lawrence Berkeley Laboratory Integrated Communication System (ICS) raceway and cable system into and throughout the building. Minimum conduit size: ¾". Telephone outlets: 4.5" square, 2" deep boxes with plaster ring.

B. Wireways for data and communications cables, between telephone closet, offices and laboratories shall be 8" x 8" minimum, lay-in square duct.

C. Microphone, speaker system, audio visual equipment in main training room and conference room.

D. Building wide paging system with battery-powered amplifiers, surface mounted speakers. System shall connect to the Lawrence Berkeley Laboratory disaster-alert system.

SECTION 16721: FIRE ALARM DETECTION SYSTEMS

PART 1 GENERAL SCOPE

A. Flow switches to indicate sprinkler zone water flow.

B. Tamper switches on all sprinkler water valves.

C. Alarm signal, on sprinkler water flow, to central fire station.

D. Manual fire call boxes.

E. Building fire alarm bells with strobe lights.

F. Equipment must be compatible with Lawrence Berkeley Laboratory existing fire alarm system.

G. Supervision on all fire alarm circuits.

H. Ionization smoke detectors for HVAC units, elevator recall and document storage areas.

I. PRODUCTS: Manufactured by Pyrotronics., Division of Siemens Corp., Multi-alarm VI, System 3, no substitutes.

SECTION 16727: SECURITY ACCESS SYSTEM

PART 1 GENERAL SCOPE

A. Security Components: proximity cards, readers, and Micro/5 PXN's, electrical door hardware, associated monitoring devices, field panels and cabling.

B. The MICRO/5 PXN Controller: Casi-Rusco System with following features:

1. MICRO/5 PXN Type "A": Casi-Rusco Micro 5/PXN.

2. MICRO/5 PXN Type "B": Casi-Rusco Micro 5/PXN Network Micro with pcmcia modem card and micro-code installed.

3. MICRO/5 PXN Type "C": Casi-Rusco Micro-5/PX Short Haul Modem.

4. MICRO/5 PXN Type "D": Casi-Rusco Micro-Prox Limited Door Micro.

C. Card Readers: Casi-Rusco Model 940, 941, 970, 971 or 990 as required by the application.

D. Electric Locking Devices: 24 VDC, continuous duty, fail secure, Mortise Lock Device, Von Duprin Model as specified on the construction drawings.

E. Power Transfer Hinge: ACI, Hagar, Monthard, Stanley or equal full mortise, butt hinge with concealed wires. All hinges shall be rated heavy-duty.

F. Magnetic Alarm Contacts: Type Sentrol, model as required by the type of installation per construction drawings.

G. Request-to-Exit (REX) Sensors: Detection Systems Model DS-150i (Light Grey) or DS-151i (Black)

H. Power Supplies: Altronix SMP-10PM (board only) 12 VDC with T28300 Transformer for Micro/5PXN, Card Readers and Request to Exit Sensors; Altronix SMP-10PM (board only) 24 VDC with T28300 Transformer for each lock relay; and Yuasa Model NP7-12, 7 A/H Batteries for stand-by power.

I. Enclosures: Hoffman enclosures, sizes as specified.

J. Fuse Board: Base Electronics, Inc. Model LV-8A Fused Low Voltage Power Distribution Board with eight fused outputs.

SECTION 16915: LIGHTING CONTROL SYSTEM

PART 1 GENERAL SCOPE

A. The purpose of the project is to control the "on/off" operation of specific lighting and space conditioning systems. The means of accomplishing this is through the

installation of individual room lighting "occupancy sensors" to control the operation of the lighting and space conditioning systems utilizing both infrared and ultrasonic sensing technologies. Provide set of relay contacts for input to HVAC system.

B. Combination infrared and ultrasonic ceiling mounted sensors with time-delay and a manual override shall be utilized.

7. Energy Conservation

The DOE and Lawrence Berkeley National Laboratory (LBNL) policy is to design energy-efficient buildings based on the Federal Life-Cycle Cost Rule. The Research Support Building shall be certified to the highest cost-effective level in the Leadership in Energy and Environmental Design (LEED™) and Energy Star[4] building rating systems. Initial goals are a LEED Gold rating and an Energy Star rating of 90 or above.

The analysis methods to be employed during Titles I and II design phases of the facility shall comply with California Title 24 and 10 Code of Federal Regulations (CFR), Part 435 Interim Rule. It is the responsibility of the A/E firm to determine the specific requirements stipulated by these documents.

The basic building design shall include the following components: a Facility Monitoring and Control System (FMCS), Metering, and energy-efficient Lighting, HVAC, Water Heating, and Power Distribution Systems.

7.1 Applicable Codes and Standards

1. Energy Conservation Performance Standards for New Federal Buildings; Code of Federal Regulations 10 CFR, Part 435 Interim Rule (mandatory for LBNL).
2. Greening the Government through Efficient Energy Management, Executive Order 13123.
3. California Administrative Code, Title 20, Chapter 2, Subchapter 4, Article 1 Building Efficiency Standards and the compliance requirements of Title 24, Part 2, Chapter 2-53 (Title 24).
4. Life-Cycle Costing Manual for the Federal Energy Management Program, National Institute of Standards and Technology, Handbook 135 (Handbook 135).
5. Leadership in Energy and Environmental Design Green Building Systems.
6. Energy Star Buildings Portfolio Manager.

7.2 Design Requirements

An Energy Conservation Report (ECR) shall be developed. The ECR shall summarize the evaluations of Energy Conservation Measures (ECMs) for the project based on lowest Life-Cycle Cost per Handbook 135. The potential measures include, but are not limited to, alternatives in equipment and systems for fenestration, lighting, insulation, air leakage, heating,

cooling, power, renewable energy, and controls. Federal Life-Cycle Cost (LCC) Rule analysis procedures shall be performed per Handbook 135 requirements.

Design comparisons shall be between the Title 24 Baseline Design and more energy-efficient alternative designs.

7.3 Components

The following items shall be included in the design of each new building or building addition to comply with minimum LBNL IHEM Design Policy:

Facility Monitoring and Control System (FMCS)

All mechanical systems shall be monitored and controlled by the sitewide Johnson Controls Metasys™· FMCS. The FMCS employs a multi-level distributed processing architecture connected by a local area network. A Central Operator's Terminal (COT) acts as the host and performs the highest level of processing. It communicates with both the system operator and the Field Processing Units (FPUs). Existing COTs will be used on this project.

The FPUs are microprocessor-based and perform specified data acquisition and stand-alone control functions of timed events, conditional control sequences, and Proportional-Integral-Derivative (PID) control (refer to Section 6, Outline Specifications, Division 15).

Lighting Systems

Daylighting Controls. Lighting fixtures in all spaces that have access to natural light shall utilize dimming controls designed to reduce electrical lamp intensities to maintain a minimum illumination level on the working plane (typically 40 fc). This is necessary to maximize the energy-saving benefits provided by natural daylighting of these spaces (refer to Section 6, Outline Specifications, Division 16, Electrical). In addition, consideration should be given to providing overhead light from skylights at the top floor of proposed structures. Skylights shall be sized to admit adequate light but restricted in size to avoid excessive heat gain and heat loss. Where appropriate, diffusing screens will be placed over the skylights to prevent uncontrolled solar radiation from striking the work

Occupancy Controlled Lighting, HVAC, and Plug Loads. Occupancy sensors that combine both infrared and ultrasonic technologies shall be used (in addition to local manual switches) to control lighting, and as an input to the FMCS for HVAC temperature control and override. Plug loads shall be connected to workstation occupancy controls.

High Efficiency Lighting. Where applicable task ambient systems shall be incorporated. These will provide sufficient lighting for ambient conditions (typically less than 20 fc) and also provide high efficiency task lighting.

Where Task ambient lighting cannot be used ceiling mounted fluorescent fixtures will be used. The lighting system will be designed to provide on average 40 to 50 fc on the working plane. In addition to daylighting and occupancy sensor control, lighting shall include user-preference for light level and central control for load management.

The lighting will be designed to minimize high contrast areas except where they are desired for a specific purpose (e.g. display lighting). Ceiling fixtures shall utilize solid state high frequency (electronic) ballasts (refer to Section 6, Outline Specifications, Division 16, Electrical).

Where recessed cans are required these shall use compact fluorescent lamps and electronic ballasts. These fixtures shall be designed for that specific lamp and will not be A-lamp retrofits. 277-volt power shall be used for lighting.

Exit signs shall be electroluminescent type.

Outdoor lighting shall be fluorescent with motion sensor control.

Incandescent lighting will not be used unless proven to be life-cycle-cost-effective.

Motors

Premium Efficiency Motors. Motors of one half horsepower and larger shall be three-phase, 460 volt. All motors shall be highest efficiency available (refer to Section 6, Outline Specifications, Division 15, Mechanical).

Solid State Motor Starters. Where constant-speed motors are used, motor starters shall use solid state technology for overload protection (refer to Section 6, Outline Specifications, Division 16, Electrical). Thermal overload protection devices are prohibited.

Variable Frequency Drives (VFDs). Main pump and fan motors shall be controlled by VFDs when loads served by these units vary as a function of their normal operation. Standby pump and fan motors can use constant-speed motors to minimize life-cycle costs.

Air Handling System

Economizers. Outside air economizer dampers and controls shall be provided on all return air systems.

Metering

Source energy measurement or "metering" shall be provided that complies with Code of Federal Regulations 10 CFR Part 435 Interim Rule. When energy services are required to be "arranged to provide" metering, the design and layout of these services shall be segregated and physically organized to facilitate portable meter installation(s).

Incoming Utility Services. Each distinct utility-provided energy service shall be metered to measure and record the amount of energy being delivered, based on energy content.

Tenant Spaces. The electrical delivery system to tenant spaces shall be arranged to provide metering of tenant electrical services when the tenant load is greater than or equal to 100 kVA and the total building load is greater than 250 kVA. Metering of tenant natural gas use is not required.

Electrical and Mechanical Subsystems. The electrical energy delivery to the subsystem(s) shall be arranged to provide separate metering when the total building load exceeds

150 kVA. Actual metering is required to be installed when the subsystem load is greater than 100 kVA or 300,000 BTUH and the total building load exceeds 150 kVA or 500,000 BTUH. The seven electrical and mechanical subsystems include lighting and outlet services, space heating, space cooling, service water heating, HVAC delivery systems, production processes, and auxiliary systems.

Equipment. Equipment shall be arranged to provide for the metering of energy inputs and outputs (flow, temperature, pressure, etc.) to determine equipment energy consumption or installed performance capabilities and efficiencies of all heating, cooling, and HVAC equipment greater than 20 kVA or 60,000 BTUH energy input.

7.4 Identified Energy Conservation Opportunities

The following is a list of identified energy savings opportunities that should be incorporated in the building design when cost effective. However, this list provides a starting point only and is not meant to exclude other energy conservation measures.

Opportunity #1

Major User: Building Envelope.

Alternative: Increased Wall and Ceiling Insulation: Increase wall insulation to R-19 and ceiling to R-30.

Alternative: Appropriate Glazing: In most perimeter areas provide insulated glass that has a U value less than 0.3. In addition, ensure that all double paned glass are supplied with low emissivity coatings and inert gas fill. All glass should have the lowest practical Heat Gain Coefficient (SHGC), typically less than 0.58. This should not be achieved at the loss of visible transmission which should be maintained above 0.65. All glass should have a "Glazing Luminous Efficacy" (Ke) of more than 1 (Ke=VT/SHGC).

Justification: Reduced heating and cooling loads improve comfort while reducing capital, operating, and maintenance costs of the building's HVAC system. Glazing with higher visible transmission allows increased use of natural light, reducing lighting energy costs.

Opportunity #2

Major User: Lighting & Building Envelope

Alternative: Daylighting Systems: Design the envelope to provide useful daylight as an offset to electrical lighting. This can be achieved by designing the spaces of the building to be close to an outside wall, sizing and placing windows and skylights appropriately, incorporation of light shelves and shading devices, and providing controls to dim or turn off the electrical lights. Combined occupancy sensor, daylight dimming, and personal-preference dimming should be considered.

Justification: Electrical lighting can consume 40 to 60% of the total energy use in commercial buildings. Good daylighting design can reduce this by as much as 60% in areas where daylight is available while improving the interior of the building itself.

Opportunity #3

Major User: Ventilation and Air Distribution System.

Alternative: Natural ventilation shall be considered, using windows and skylights with operable sashes.

Alternative: Variable Air Volume (VAV): VAV systems shall be considered, including the use of under-floor supply plenums with user-adjustable air flow grilles and above-ceiling exhaust plenums. Additional features to consider: low velocity ductwork, filters, and coils; air foil or vane-axial fans; synchronous drive belts or direct-drive fans.

Alternative: Heat Recovery System: Investigate the use of a heat recovery system incorporating a runaround coil or heat pipe arrangement to transfer energy between inlet building air stream and the exhaust air stream of the building.

Justification: Natural ventilation reduces the amount of air that must be provided by fans and increases occupant comfort. VAV systems offer energy conservation by reducing average air flows, thereby reducing the need for heating and cooling energy and motor energy required by circulation pumps and fans. Low velocity ducts and plenums using floor-to-ceiling air flow in the occupied spaces require less fan power and cooling (since temperature stratification is encouraged in the space). Large amounts of energy are required to condition the ventilation air stream; any opportunity to recover energy from these air streams warrants examination.

Opportunity #4

Major User: Water Distribution for Space Conditioning.

Alternative: Valves: Control valves for heating and cooling coils shall be two-way when VFD pumps are installed.

Alternative: Piping: Piping systems should be designed to minimize water velocities. Water piping loops should be designed to allow for variable flow when appropriate.

Justification: Variable flow systems offer energy conservation by reducing pumping power required.

Opportunity #5

Major User: Water Distribution and Space Conditioning

Alternative: Consider using hydronic systems for space conditioning, including radiant panels (wall or ceiling mounted) for both heating and cooling and also in-floor radiant systems where loads and building use is appropriate.

Justification: Radiant systems allow drybulb temperatures to vary through a wider range than air delivery systems while maintaining high levels of comfort. The systems are more energy efficient and quiet.

Opportunity #6

Major User: Space Conditioning Systems: Precooling, Passive Solar

Alternative: Consider using the FMCS to control precooling of the building at night during heat storms. This can be achieved by programming the FMCS to recognize such weather patterns and follow a protocol that reduces the temperatures in the building at night during unoccupied times.

Justification: Summer and Fall at Berkeley are usually mild punctuated with short overheated periods lasting about a week twice a season. These are the periods of highest electrical demand in the Bay Area. Pre-cooling the structure at night lowers the demand during the day and helps the Laboratory flatten the electrical demand.

Opportunity #7

Major User: Boilers

Alternative: General: Boilers should have forced draft or pulse combustion burners and be capable of daily cold starts without reduced life or increased maintenance. Full jacket insulation and electronic ignition should be provided.

Alternative: Isolation Valves: On multiple boiler installations, consider providing motorized isolation valves to be controlled by the FMCS.

Alternative: Modular Boilers: Consider providing installations with multiple boilers to act as modules to meet load demands of the building.

Alternative: Full Condensing Boilers: Full condensing type boilers should be considered.

Alternative: Modulating Boilers: Boilers with modulating burners should be considered.

Justification: Standby and cycling losses account for major portions of energy use by natural gas fired boilers. These measures will minimize these losses, improve operating efficiency, and increase the reliability of space heating boilers.

Opportunity #8

Major User: Domestic Hot Water.

Alternative: Domestic Hot Water (DHW) Heaters: Instantaneous electric water heaters should be used for lavatory sinks and connected only to the cold water supply. If there are showers in the building, a condensing-type stand-alone water heater or tank and heat exchanger from the condensing-type HHW boiler should be used; DHW piping should be equipped with electric trace heating and be insulated to the highest cost-effective level. Open-flue gas-fired heaters, remote electric storage water heaters, and pumped-recirculation systems should not be used

Justification: Reduced standby losses, increased efficiency, reduced maintenance cost, and reduced first cost.

Opportunity #9

Major User: Space Cooling

Alternative: Indirect/Direct Evaporative Cooling: Review application of Indirect/Direct Evaporative Cooling instead of, or to supplement, refrigerated cooling systems. Consider innovative strategies such as use of the building exhaust air or air cooled by indirect evaporative coolers as a source of evaporation air for the indirect evaporative cooling.

Alternative: Variable Speed Option or Staged Compressor Option: Consider the use of staging or modulation as manufacturer allows to satisfy low load operation.

Alternative: Heat Recovery System: Consider a heat recovery system that will transfer waste heat energy from the chiller system to other applications.

Alternative: Electronic Expansion Valves: When available, the use of an electronically controlled expansion valve on reciprocating chillers will allow a closer matching of the chiller capacity to the load.

Alternative: Condenser/Evaporator Options: The largest available condenser and evaporator should be utilized. Consider providing water-cooled or evaporative-cooled condensers. Otherwise provide evaporative pre-cooling of the standard air-cooled condenser.

Alternative: Isolation Valves: Motorized isolation valves should be provided on multiple chiller installations to be controlled by the EMCS.

Alternative: Consider using Evaporative Pre-Cooler on outside air intake to reduce the temperature of the incoming air to the building.

Justification: Major energy savings can be realized by utilizing Indirect/Direct Evaporative Cooling in addition to simplified maintenance. Implementing the chiller plant opportunities will make the plant more efficient throughout the range of operation, saving energy and wear on equipment.

Opportunity #10

Major User: Cooling Towers and Evaporative-Cooled Condensers.

Alternative: Water Treatment: Study ozone water treatment for energy and water savings.

Alternative: Consider using variable-speed tower fan(s) to reduce tower water pumping energy.

Alternative: Consider using large cross-section, low-head tower.

Alternative: Size tower to minimize life-cycle cost of entire cooling plant.

Justification: Reduced energy and chemical use, increased life, higher performance.

Opportunity #11

Major User: Electrical Power Distribution

Alternative: Transformers: High efficiency transformers should be used.

Alternative: Conductors: Consider using larger feeder and circuit conductors than required by code.

Alternative: Use available capacity on Building 2's transformers.

Justification: Energy savings result from increased efficiency; longer life due to cooler operation. Already-existing transformers reduce no-load losses.

Opportunity #12

Major User: Electrical Power Supply

Alternative: Consider using building integrated photovoltaics as components of the building skin. This can be accomplished by using them as part of spandrel glass in curtain wall systems, as a wall cladding material, or as part of the roof.

Justification: The current prices of photovoltaics are at a point where their power slightly exceeds the cost of on peak electricity. As they generate their power during that time they can be cost effective over time. In addition, if they are widely applied, they increase the reliability of the electrical distribution system, provide a viable environmentally benign alternative, require low or no maintenance and are silent.

Opportunity #13

Major User: Elevators.

Alternative: Consider using a traction elevator with regenerative elevator drive, instead of a hydraulic elevator.

Alternative: Consider using solid state vector-control power supply.

Justification: Traction elevators use a counterweight and are thus inherently more efficient than hydraulic elevators Regenerative drives and vector controls save energy and reduce maintenance costs.

8. Environment, Health and Safety Considerations

8.1 Integrated Safety Management

Design and construction of the Research Support Building will be governed by the Lawrence Berkeley National Laboratory (LBNL) Integrated Safety Management (ISM) System. The LBNL project team will incorporate the core ISM principles and guiding functions from project conceptual development through completion of construction. Following completion, the responsible management will fold the operation and maintenance of the completed facility into the existing safety management infrastructure. Contractors performing specified work will be compelled to embrace LBNL safety philosophy, and through binding contract language, the LBNL procurement group will insure that contractors are fully integrated into the LBNL safety management system.

8.2 Building Occupancy and Use

Programmatic activities conducted in the Research Support Building will be office activities. A staff of approximately 70 will occupy the building. Many of the personnel housed in the building will be personnel already employed at LBNL. Parking availability is planned for a maximum of 1.7 FTEs per parking space at LBNL, as established in LBNL's Long Range Site Development Plan and approved by DOE and the University (backed by CEQA document).

The project will incorporate the use of increased increments of electricity, gas and water and will be accommodated by the capacity of existing utility systems serving the LBNL site.

8.3 Safety Considerations

Systems, design, and operational environment, health, and safety considerations will be integral parts of all project elements. Project elements will include planning, design, construction, and operational safety of new building components, systems, and equipment. Lawrence Berkeley National Laboratory will design and execute this project in a manner that does not compromise the safety or health of workers, the public or the environment. All work will be consistent with the standards promulgated under Section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order No. 12196, the related Safety and Health Provisions for Federal Employees of the Secretary of Labor (CFR Title 29, Chapter XVII, Part 1960), and the University of California – DOE LBNL contract Necessary and Sufficient Work Smart Standards (WSS) set.

Specific environment, health, and safety (EH&S) requirements for design and engineering, construction, and operations will be derived from LBNL Publication 3000 (EH&S

Safety Manual) and guided by the standards and codes within the Necessary and Sufficient (WSS) set.

The Project Execution Plan will provide the overall framework for instituting LBNL Integrated Safety Management in all project phases and at all tiers of project participation, including lower tier subcontractors.

Hazards included in the operation of the building will be of the type and magnitude routinely encountered and/or accepted by the general public. A Safety Analysis Review will not be required.

Design

Design and engineering will be conducted as a collaborative multi-disciplinary effort by a team that includes not only Facilities architects, engineers and project managers but industrial hygiene, environmental protection, design and construction safety, ergonomics and fire protection professionals from the LBNL Environment, Health and Safety (EH&S) Division. Key planners, management, and user representatives of the entity under design will provide critical input into the design process. Our initial systems safety objectives will be preliminary identification, evaluation, and analysis of hazards with the goal of maximizing mitigation of potential EH&S issues during the design of all new building components, systems, and equipment - both from a constructability and operations perspective.

The building and nonstructural building elements will be designed for a site-specific maximum anticipated earthquake on the nearby Hayward Fault and to special seismic design requirements in Chapter 23, LBNL Health and Safety Manual. A consulting structural engineer experienced in earthquake engineering will provide a third-party design review.

The Research Support Building design and construction will be in accordance with applicable building and other architectural and engineering code requirements. Building permits from local authorities are not required for Laboratory construction on University-owned land and therefore will not be obtained. The Lab and its engineering consultants will design to all applicable codes and provide inspection for code compliance during construction.

The preliminary safety and hazard assessment generated during design phase will serve as the overall safety basis for design, construction, and operation of installed facility attributes.

Construction Safety

The existing building on the site, which had become structurally unsound, is being deconstructed. The hazardous materials that were identified in the building survey (asbestos and lead paint) were removed by a qualified abatement contractor.

Construction safety issues that require hazard assessment and control measures include crane and rigging operations, excavation and related shoring, heavy equipment utilization, welding and torch cutting, coating application, and other potential hazards normally associated with a large-scale construction project. The construction contract specifications will require the contractor to comply with the requirements of federal and state OSHA, LBNL Publication 3000 Health and Safety Manual, California Building Codes, and any other applicable regulations in our LBNL Necessary and Sufficient WSS set or requirements otherwise identified prior to or during performance under the contract.

Contractors performing construction will be required by contract to develop and implement a project specific health and safety program (HASP) that serves as their safety basis for performing specified work. The HASP will document how the contractor implements ISM in their work process and will provide detailed provisions for work site inspection, hazard identification and mitigation, and safe work execution. The HASP will be submitted to and approved by LBNL prior to commencement of work.

Construction monitoring activities will be shared by several LBNL organizations. The Procurement Department will be responsible for ensuring contractor compliance with contract terms and conditions. Facilities Department personnel will serve as LBNL project and construction management representatives, will be responsible for successful execution of the work including quality assurance and safety, and will be the Laboratory's prime contact with the contractor.

The LBNL Construction Safety Engineer will monitor the construction site for compliance with LBNL, DOE, CAL/OSHA, federal OSHA, and other applicable safety requirements. This compliance monitoring will be carried out in concert with LBNL Facilities Department, Procurement, and line management. Monitoring activities will include validation of the contractor's ISM program, apprising contractor of safety criteria pertaining to the construction project, conducting and documenting frequent inspections to verify contractor safety compliance, and ensuring that the construction contractor meets ongoing EH&S submittal requirements.

The Lab and contractors performing construction activities will address transportation safety and planning in a formal Transportation Plan. Transportation of equipment, materials and debris will be scheduled and routed to minimize impact on Lab personnel as well as the surrounding community. Coordination of oversized load movement and road closures will be through the Lab Fire Department, the project management team, and Lab security.

Fundamental to all work at the Lab, all personnel, including contractor and subcontractor personnel performing construction activities are empowered with 'Stop Work' authority if an imminent danger situation is noted.

8.4 Environmental Considerations

Relationship to the Ambient Site Environment

There are no natural environmental issues that will require unusual design considerations. The project is not located on or in relation to, and will not impact any environmentally sensitive areas, such as a flood plain, wetland, archaeological, or critical habitat site. Construction will have a minimal impact on existing plants, trees or groundcover. Where existing conditions are disturbed by construction activities, the area will be restored to its pre-project condition. No conflict with local ecological planning or community organizations is expected. The project will have no significant impact upon atmosphere, climate, flora, or fauna.

Sub-surface conditions are unlikely to contain any hazardous conditions. In 1992, the California Department of the EPA, Department of Toxic Substances Control (DTSC) and Berkeley Lab conducted a RCRA Facility Assessment and identified all solid waste management units and areas of concern throughout the Laboratory. All these units were thoroughly

investigated, from 1999 through to September 2000. Ground water plumes were characterized and the extent of the contamination identified. According to these findings, no ground plume or solid waste management units were identified under the proposed building site.

Covering excavation spoils, installation of silt traps and fencing, and use of filter fabric and other measures to protect surface drains and storm sewers will control erosion and sedimentation during construction. Cement truck washout to LBNL drains or surfaces will not be allowed. Contractors will be required to adhere to the standards of storm water pollution prevention set forth in LBNL's Storm Water Pollution Prevention Plan under the California General Permit for Stormwater Associated with Industrial Activities.Storm water collection and management will be addressed by the Lab Facilities engineers and EH&S Division Environmental Services group during building and parking area design and construction. Existing storm drains will accommodate the net capacity requirement changes.

Waste Management

All potentially hazardous materials were removed from the site during the deconstruction of the previous building. All hazardous wastes were disposed of in accordance with LBNL procedures and federal and state regulations.

Contract specifications will hold contractors responsible for the legal and proper management (characterization, packaging, storage, transport, and disposal) of contractor owned or generated wastes associated with their own equipment or work processes. Transportation of waste and debris non-contaminated, contaminated or hazardous – will be planned and covered in a comprehensive Transportation Plan.

The contract will stipulate that the contractor immediately notify LBNL if the contractor suspects that materials which were previously identified in the contract as non-hazardous, are in fact hazardous or if new materials or substances are encountered that have not been addressed in the contractual scope of work.

9. Detailed Supporting Data

Detailed Cost Estimate

Structural Calculations

Geotechnical Report

CAMP Rating

Life Cycle Cost Analysis

Cost Effectiveness Analysis

ED&I Analysis

RESEARCH SUPPORT BUILDING

ED&I ANALYSIS
($K)

LBNL Activities		Effort	Duration	MM		$
Title I				8.4		130
	Proj Eng	0.25	8	2.0		
	Proj Team	0.80	8	6.4		
Title II				13.8		215
	Proj Eng	0.25	12	3.0		
	Proj Team	0.90	12	10.8		
Title III				5.8		90
	Proj Eng	0.10	20	2.0		
	Proj Team	0.19	20	3.8		
Inspection						
	Inspectors	0.63	20	12.6		196
Consultants						47
	Geotech			13		
	Survey			5		
	Seismic			3		
	Cost Est.			10		
	Testing Labs			16		
					s/t LBNL	678
A/E Activities						1,282
13.0% of Construction Cost ($9,840)						

	Design	Construction Support	Design Support	Total	% of Fee
Title I	220		168	388	30%
Title II	370		271	641	50%
Title III		253	0	253	20%
s/t design	590	= 6% of const cost			

		Total ED&I	**1,960**
FY02 Berkeley Lab Rate		$13.84 K/MM	
Escalation to May 2006 @	12.25%	$15.54 K/MM	

LBNL LIFE CYCLE COST ANALYSIS
RESEARCH SUPPORT BUILDING

Current Dollars Analysis - Discount and Escalation rates are NOMINAL (inclusive of general inflation)

Project: Research Support Building **Location:** LBNL Berkeley, CA.		**"A" COST OF 26,000 GSF LEASED BLDG IN BERKELEY**		**"B" COST OF 26,000 GSF OWNED BLDG AT LBNL**		**Notes & References**	
All Estimates are dollars of FY	**2006**						
PROJECT LIFE CYCLE ANALYSIS (YEARS)	**25**						
REAL OMB DISCOUNT RATE (30 YR)	**3.7%**						
CALCULATED OMB GENERAL INFLATION	**1.8%**	**BASE CASE**					
NOMINAL OMB DISCOUNT RATE INCLUDING INFLATION	**5.6%**	**($K)**		**($K)**		**BY**	**Note #**
A. Initial Capital Costs		**One-Time**	**PV**	**One-Time**	**PV**		
1 Demolition							
2 Sitework and Core Building				9,803	9,803	DK/RS	A2B
3 Engineering, Design, Insp. & Proj. Mgmt. (EDIA/PM)				2,551	2,551	DK/RS	A3B
4 Tenant Improvements		2,730	2,730	2,100	2,100	DK/RS	A4A,B
5 Tenant Improvements EDIA/PM		710	710	546	546	DK/RS	A5A,B
Total Initial Capital Cost		3,440	**3,440**	15,000	**15,000**		
B. Energy & Utility Costs	**UPV**	**Annual**	**PV**	**Annual**	**PV**		
1 Electricity	16.1	37	598	22	356	DK/DL	B1A,B
2 Natural Gas	19.6	15	297	14	266	DK/DL	B2A,B
Total Energy & Utility Cost		52	**895**	36	**622**		
C. Operation, Maintenance, and Repair Cost	**Esc.**	**Annual**	**PV**	**Annual**	**PV**		
1 Maintenance	1.8%	162	3,221	147	2,928	DK	C1A,B
2 Custodial	1.8%	31	627	29	570	DK	C2A,B
3 Productivity (Gains)/Losses	1.8%	189	3,764	(378)	(7,528)	DK	C3A,B
4 Lease Costs	1.8%	1,007	20,046			DL/DD	C4A,B
Total Operation/Maintenance (PW) Costs		1,389	**27,657**	(202)	**(4,030)**		
D. Replacement Costs	**Yr** **Esc.**	**One-Time**	**PV**	**One-Time**	**PV**		
1 Replace Domestic Water Heater	15 1.8%			7	5	DK	D1-4B
2 Replace Air Handling/Cooling Equipment	20 1.8%			96	67	DK	D1-4B
3 Replace Heating Hot Water Equipment	20 1.8%			52	36	DK	D1-4B
4 Replace Roof	20 1.8%			100	70	DK	D1-4B
Total Replacement (PW) Costs				255	**178**		
E. Residual Value	**Yr** **Esc.**	**One-Time**	**PV**	**One-Time**	**PV**		
1 Original Capital Components	25 1.8%			(7,842)	**(4,981)**	DL	E1B
Total Replacement (PW) Costs				(7,842)	**(4,981)**		
F. Comparative Analysis							
1. Total Present Value of Life Cycle Costs			**$31,992**		**$6,789**	DL	F1
2. Net Savings from Alternative Compared to Base Case					**$25,203**	DL	F2
3. Equivalent Annual Savings					**$1,008**	DL	F3
4. Savings-to-Investment Ratio					**4.73**	DL	F4
5. Internal Rate of Return					**12.4%**	DL	F5
6. Simple Payback occurs in year					**7**	DK/DL	F6
7. Discounted Simple Payback occurs in year					**8**	DK/DL	F7

PV - Present Value UPV = Uniform Present Value Factor

Adapted from National Institute of Standards and Technology *Handbook 135* and *BLCC 5.0-01, Building Life Cycle Cost, April 2001,* and is
- Federal Life Cycle Cost Methodology and Procedures, 1- CFR, Part 436, Subpart A
- Lease vs. Purchase analysis requirements of *OMB Circular A-94*.